THE

JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

[Registered as a Newspaper.]

Vol. XXXIII. No. 841.] LONDON, JUNE 24, 1879. [31st Year.] Price 6d.

GAS PURIFICATION
BY
OXIDE OF IRON.

COOKE BROS.,
CENTRAL DEPÔTS:
CO. DONEGAL, IRELAND;
LONDON DEPÔT:
BLACKWALL, E.;
OFFICES:
26, 27, & 28, FENCHURCH ST.,
LONDON, E.C.

GENUINE TORBAY PAINT
And SPECIAL GASOMETER PAINT.
Several Prize Medals. Established over 20 Years.
These Paints are now used in over 200 Country Gas-Works, and by all the London Gas Companies, on Gasholders, Scrubbers, Purifiers, &c. Also used by the Admiralty, War Office, Railway Companies, Founders, &c. They prevent and arrest rust, and protect iron from the action of water, sulphurous and gaseous exhalations; do not crack, blister, or flake off; will cover tar effectually.
The covering powers are considerably greater than those of any other Paint.—*See "Engineer," Nov. 2, 1866.*
Supplied, mixed ready for use, or in paste, as desired.
TORBAY PAINT COMPANY.
Proprietors: STEVENS & CO.,
21, GREAT WINCHESTER STREET, LONDON.
Works: BRIXHAM, TORBAY.

THOMAS PROUD,
BROOKFIELD GAS APPARATUS WORKS,
103, ICKNIELD STREET EAST, BIRMINGHAM.
CONTRACTOR FOR
LAYING MAINS
FOR
Gas, Water, & Sanitary Purposes,
AND MANUFACTURER OF
WOOD GRIDS
FOR
SCRUBBERS AND PURIFIERS.

COWEN'S PATENT FIRE-CLAY RETORTS.
JOSEPH COWEN and CO.,
BLAYDON BURN, BLAYDON-ON-TYNE,
Were the only parties to whom a Prize Medal was awarded at the Great Exhibition of 1851, for "Gas-Retorts and other Objects in Fire-Clay," and they were also awarded at the International Exhibition of 1862, the Prize Medal for "Gas-Retorts, Fire-Bricks, &c., for Excellence of Quality."
J. C. and Co. have been for many years the most extensive Manufacturers of Fire-Clay Retorts and Fire-Bricks in the Kingdom. Orders for Fire-Clay Retorts of all shapes and dimensions, and to fit any shaped Mouthpiece, Fire-Bricks, and every other article in Fire-Clay, are promptly executed at their Works as above.
COWEN'S GARESFIELD COALS.
Jos. Cowen & Co. are the only Manufacturers of Fire-Bricks and Clay Retorts at Blaydon Burn.

JOHN RUSSELL & CO.,
LIMITED,
Established at the commencement of Gas Lighting,
Manufacturers of
TUBES AND FITTINGS.
THREE PRIZE MEDALS,
Paris, 1878.
Head London Office:
145, QUEEN VICTORIA STREET.
ALMA TUBE-WORKS, WALSALL;
OLD PATENT TUBE-WORKS, WEDNESBURY.

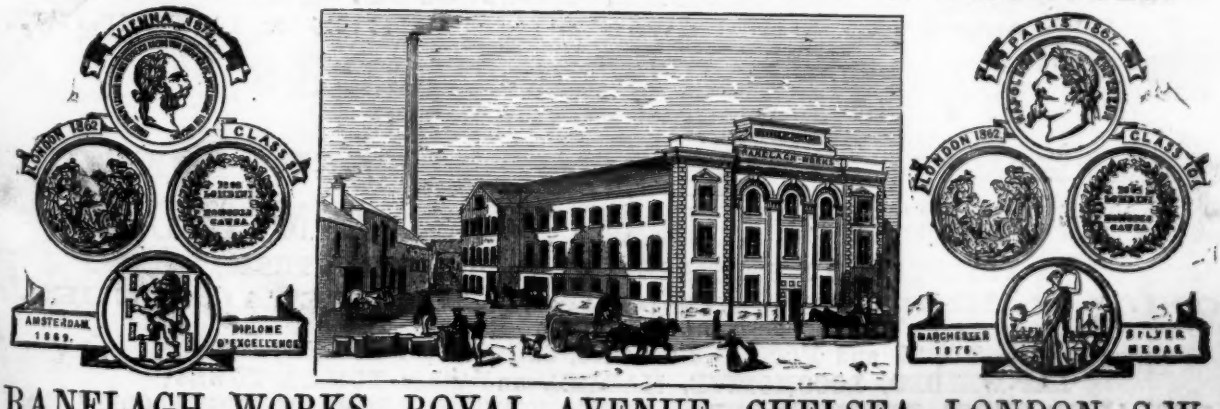
JOHN BENT & SON,
BELL BARN ROAD, BIRMINGHAM,
MANUFACTURERS OF
WET AND DRY GAS-METERS,
Licensees and Manufacturers of
HUNT'S
PATENT COMPENSATING METERS,
STREET-LAMPS, &c., &c.
Established 1830.

THOMAS PIGGOTT & CO.,
SPRING HILL, BIRMINGHAM,
MANUFACTURERS OF
TELESCOPIC & SINGLE GASHOLDERS,
CAST & WROUGHT IRON TANKS FOR DITTO,
And Gas Apparatus of every Description.
Marine, Tubular, Cornish, Plain, Furnace, Saddle, and Range Boilers.
Sugar, Saltpetre, and all kinds of Pans.
Roofs, Girders, and Bridges, and General Smith's Work.
London Offices: 97, CANNON STREET—
JAMES E. & SAMUEL SPENCER, Agents.

THE
"OTTO" GAS-ENGINE.
See Page 962.
CROSSLEY BROTHERS,
MANCHESTER AND LONDON.

THE
NITSHILL COMPANY'S
DUKE OF HAMILTON'S
LESMAHAGOW
CANNEL COAL.
AGENT:
JAMES M'KELVIE,
HAYMARKET,
EDINBURGH.

CHANGE OF ADDRESS.
GEORGE GLOVER AND CO.,
DRY GAS-METER MANUFACTURERS,
HAVE REMOVED TO MORE EXTENSIVE PREMISES:



RANELAGH WORKS, ROYAL AVENUE, CHELSEA, LONDON, S.W.

SILVER MEDAL, PARIS EXHIBITION, 1867.

LLOYD AND LLOYD,

ALBION TUBE-WORKS, BIRMINGHAM,

AND

COOMBS WOOD TUBE-WORKS, HALESOWEN,

MANUFACTURERS OF

WROUGHT-IRON TUBES AND FITTINGS,

AND

LAP-WELDED IRON AND HOMOGENEOUS METAL BOILER TUBES,

UP TO FOUR FEET IN DIAMETER.

London Offices: No. 4, Cloak Lane, Queen Street, E.C.

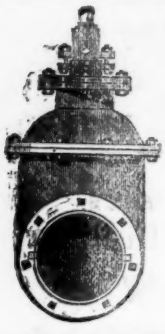
Warehouses: London, Liverpool, Manchester, and Lille.

WELLINGTON TUBE WORKS,

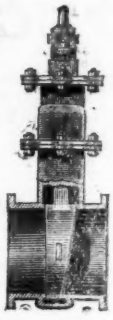
GREAT BRIDGE, TIPTON, STAFFORDSHIRE.

JOSEPH AIRD,

GAS, STEAM, AND HYDRAULIC TUBES AND FITTINGS.



C. & W. WALKERS' DOUBLE-FACED GAS-VALVES.



These solidly constructed double-faced Gas-Valves have taken the place of the old system of the light, single-faced disc, which is too uncertain and unreliable in large bores.

They are guaranteed absolutely gas-tight. They are very massive and rigid, and by improved modes of manufacture they are produced at very little excess in cost over the old light, weak system, which is liable to spring and bend, and become leaky.

The Valve is a rigid wedge of solid cast iron, having two perfectly scraped surfaced facings fitting between the two on the body, which are also surfaced.

A spring in two short halves, and, therefore, not liable to break, is used only for scraping the front facing clean.

The front facing is vertical; the back facing forms the wedge.

At a slight additional expense both flanges are faced to bolt to main-pipes.

MIDLAND IRON-WORKS,

DONNINGTON, near NEWPORT, SHROPSHIRE; 8, FINSBURY CIRCUS, LONDON.

EDWARD E. CROMBIE & CO.,

INVENTORS AND PATENTEES

OF THE

FRICTIONLESS DRY GAS-METERS,

Beg to intimate to Gas Companies and others that they are now prepared to supply these very superior Meters at the same prices as for the ordinary Gas-Meters.

In the construction of this Meter, for which the best tin plates only are used, every mechanical contrivance has been taken advantage of successfully to reduce the friction to a minimum, which is amply proved by the fact that they are made to work upon only one-fortieth of an inch pressure. By an improvement also in their construction, a steadier light is obtained, and greater capacity than can be got from any other Meter in the market. No gas can pass under the valves on any back pressure, as is the case with many other Dry Meters.

To Gas Companies supplying gas through streets with heavy gradients, these Meters are invaluable, as much gas is saved from the low pressure required to work them.

ALL METERS ARE UPHELD FOR FIVE YEARS.

METROPOLITAN WORKS, DIANA PLACE, EUSTON ROAD, LONDON, N.W.

TRADE MARK

THE MEDAL FOR 1862.

The only Prize Medal awarded for TUBES & FITTINGS.

CROWN TUBE-WORKS,

WEDNESBURY, STAFFORDSHIRE.

WAREHOUSE: SOUTHWARK STREET, LONDON.

JAMES RUSSELL & SONS, LIMITED,

PATENTEES & FIRST MAKERS OF WROUGHT-IRON TUBES,

ONLY MAKERS OF HOMOGENEOUS METAL TUBES.

MANUFACTURERS OF

TUBES and FITTINGS for GAS, STEAM, and WATER;

LAP-WELDED, LOCOMOTIVE, MARINE, and other BOILER TUBES;

HYDRAULIC TUBES, BEDSTEAD TUBES, WELL TUBES, TELEGRAPH POSTS, COILS, &c.

GAS-FITTERS TOOLS, VALVES, COCKS, &c.

THOMAS PIGGOTT & CO.,

(Established 1822,)

SPRING HILL, BIRMINGHAM.

MANUFACTURERS OF

TELESCOPIC & SINGLE GASHOLDERS,

CAST & WROUGHT IRON TANKS FOR DITTO;

PURIFIERS, CONDENSERS, SCRUBBERS, RETORTS, VALVES;

IMPROVED WROUGHT-IRON RETORT-LIDS, CROSS-BARS, & SCREWS;

AND GAS APPARATUS OF EVERY DESCRIPTION.

SOLE MANUFACTURERS OF LIVESEY'S PATENT GASHOLDER MAN-LID,

By use of which Man-lid, inlet and outlet pipes can be examined and cleansed without loss of gas in crown of holder, or ingress of atmospheric air.

ROOFS, GIRDERS, BRIDGES, AND BOILERS OF ALL KINDS.

Drawings, Specifications, and Estimates supplied on application.

LONDON OFFICES: 97, CANNON STREET—JAMES E. & SAMUEL SPENCER, AGENTS.

HONOURABLE MENTION, PARIS EXHIBITION, 1878.

J. E. WILLIAMS & CO.,

SOLE MANUFACTURERS OF THE

SPECIAL METALLIC OXIDE PAINT,

Largely used by Gas Companies, Corporations, Railway Companies, Ironfounders, and Machinists. It has the following qualifications and properties:—

EFFECTUALLY PREVENTS AND ARRESTS CORROSION
HAS A FINE GLOSS, AND IS VERY DURABLE.
DOES NOT REQUIRE DRIERS LIKE OTHER PAINTS.
PROTECTS IRON FROM ACTION OF WATER.

IS NOT AFFECTED BY SULPHURETTED HYDROGEN.
FORMS A VERY HARD TOUGH (NOT BRITTLE) SURFACE.
WILL NOT CRACK, BLISTER, OR SCALE.
IS NOT AFFECTED BY EXTREMES OF TEMPERATURE.

COVERS NEARLY DOUBLE THE AREA OF OTHER PAINTS.
(7 gallons or 1 cwt. will cover 1311 square yards of Ironwork.)
IS CHEAPER AND MORE ECONOMICAL THAN ANY OTHER.

VICTORIA PAINT WORKS, COLLYHURST, MANCHESTER.

HYDRATED PURIFYING MATERIAL.

Samples on application.

MESSRS. SPENCE BROS., LIMITED,

Will be glad to supply the above on the most favourable terms, and to treat, by Purchase or Exchange, for Spent Oxide.

PRICES ON APPLICATION.

ALSO PATENT DRY COPPERAS FOR EXTRACTING AMMONIA.

VICTORIA CHEMICAL WORKS, BRADFORD, NEAR MANCHESTER.

ROBT. DEMPSTER & SONS,

GAS ENGINEERS, IRONFOUNDERS, AND CONTRACTORS,

ROSE MOUNT IRON-WORKS, ELLAND, YORKSHIRE.

MANUFACTURERS OF EVERY DESCRIPTION OF

GAS APPARATUS;

CONTRACTORS FOR THE

ERECTION OF PUBLIC AND PRIVATE GAS-WORKS.

Plans and Specifications Prepared, and Illustrated Catalogues forwarded on application.

DANIEL HOWARD,

(Successor to the late BENJ. WHITEHOUSE),

GASHOLDER AND BOILER WORKS,

WEST BROMWICH, NEAR BIRMINGHAM (Established 1765),

MANUFACTURER OF

TELESCOPIC AND SINGLE GASHOLDERS,

WROUGHT AND CAST-IRON TANKS FOR DITTO.

PURIFIERS, CONDENSERS, SCRUBBERS, HYDRAULIC MAINS, AND ALL KINDS OF GAS APPARATUS.

WROUGHT-IRON ROOFS, BRIDGES, GIRDERS, ETC

STEAM, HOT WATER, AND RANGE BOILERS, TANKS, CISTERNS, BOATS,

AND ALL KINDS OF WROUGHT-IRON W K

Drawings, Specifications, and Estimates supplied on application.

GAS PURIFICATION

BY

OXIDE OF IRON.

GAS PURIFICATION & CHEMICAL Co., LIMITED,

PALMERSTON BUILDINGS, OLD BROAD STREET, LONDON, E.C.

JOHN WM. O'NEILL, Managing Director.

SAMUEL CUTLER & SONS,

CONTRACTORS FOR GAS & WATER WORKS, GENERAL ENGINEERS, IRONFOUNDERS & MANUFACTURERS OF

GASHOLDERS, TANKS, PURIFIERS,

SCRUBBERS, VALVES, EXHAUSTERS, IRON ROOFS, BRIDGES, BOILERS, AND GENERAL CAST AND WROUGHT IRON WORKS.

S. C. & SONS undertake the entire erection of New, or Remodelling of existing Gas-Works in any part of the World, including small Works for MANSIONS, FACTORIES, &c., or Works of the largest extent (are now constructing the largest Gasholder yet erected); also the supplying and laying of MAINS.

They make a speciality of supplying every requisite whatever for Gas-Works, keeping in Stock what are most in request. WOOD SIEVES for Purifiers and Scrubbers, of a superior make.

SPECIAL CASTINGS to Drawing or Pattern at Shortest Notice.

Manufacturers of MORRIS & CUTLER'S PATENT CONDENSER & CUTLER'S PATENT GAS-WASHER.

DESCRIPTION OF MORRIS & CUTLER'S PATENT CONDENSER.—The Condenser may consist of pipes arranged in tiers, or in any other form most convenient to the site available, each tier being connected with special connections, and containing within same either one or more coils of smaller pipe through which water is passed, being supplied from any convenient source of supply, the water passing in an opposite direction to the gas, so that the coldest water is at the gas outlet. The power of the Condenser can be regulated precisely in proportion to the quantity of water allowed to pass through, which is not in any way contaminated, but simply heated by the hot gas, and advantage can be taken of its being at a high level to carry it to a high-level cistern, from whence it can be used for supply to boiler or any other purpose. The Condenser itself may form the support for a high-level cistern. By an arrangement of valves the water may be shut off, and an air orifice opened, when air will pass through instead of water, or both air and water can be shut off. The power of the Condenser is, therefore, entirely under control. The Condenser may be seen in operation at the Brentford Gas-Works.

For further Particulars, apply to Mr. F. MORRIS, GAS-WORKS, BRENTFORD, or to

S. CUTLER & SONS, PROVIDENCE WORKS, MILLWALL (Near the Steamboat Pier), LONDON, E.

1862.

CLASS II.

HALLETT'S
PATENT ANTIMONY PAINT.

MADE ONLY BY

GEORGE HALLETT & CO.,

296, ROTHERHITHE, LONDON, S.E.

Price 30s. per Cwt. Special Driers supplied at same Price.

This light stone-coloured Paint, for which a Prize Medal was obtained in 1862, is free from certain defects of white lead. It does not produce any deleterious effect upon the health of those who use it, such as painter's colic, nor is it blackened by sulphur compounds in the atmosphere; while, from its less specific gravity and good body, it covers more surface, weight for weight, and, therefore, it is preferable and more economical than white lead.

It is peculiarly adapted for Gas-Works.

GOLDSMITH'S PATENT SIGHT WATER-LINE INDICATING GAS-METER.

MANUFACTURED BY GUEST AND CHRIMES,

FOUNDRY AND GENERAL BRASS WORKS, ROTHERHAM;

AND 85, SOUTHWARK ST., LONDON, S.E.

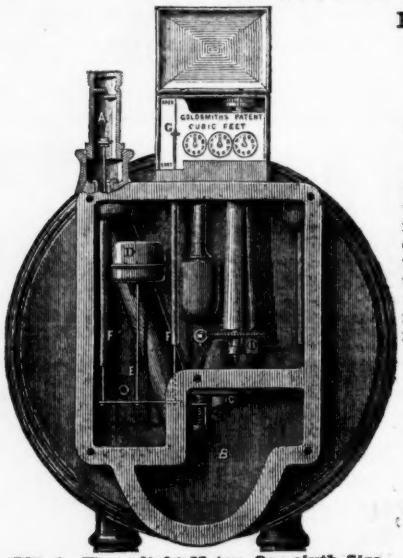


FIG. 1.—Three-light Meter, One-sixth Size

Fig. 1 is a Meter with front removed to show the arrangement and connection of the Indicator and Valve.

Fig. 2 is front view of Index, with cover up.

The principal object of this invention is to render the water-line in the reservoir at all times visible. It will be seen, by reference to the illustrations, that this is accomplished in the following manner:—On the dial are the words "Open" and "Shut," and attached to the float is the pointer G, which rises and falls with the water-line in the reservoir. If the pointer is at "Open," it shows that the valve is open, and that the reservoir is full. If it is at "Shut," it shows that the reservoir is empty, and that the gas will be shut off.

The following ADVANTAGES will be obvious:—

1. The Inspector can see at a glance if the Meter requires water.
2. No more water than is required need be added, and therefore no water has to run out.
3. The Meter Inspector will be spared a great deal of his most objectionable work, and he will save a great deal of time and trouble.
4. The consumer will not always have to be asked for water, nor will he have to endure the unpleasant smell caused by waste water being run out.

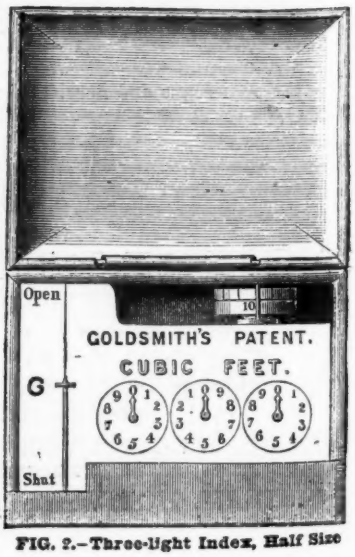


FIG. 2.—Three-light Index, Half Size

GEORGE ORME & CO.,

ATLAS METER-WORKS, OLDHAM,

MANUFACTURERS OF

WET AND DRY GAS-METERS,

STATION-METERS, GOVERNORS,

PRESSURE AND EXHAUST REGISTERS,

LAMP-METERS IN CAST-IRON BOXES,

And every Description of Gas Apparatus.

JAMES MILNE & SON,

GAS ENGINEERS,

Gas-Meter, Gas Apparatus, and Gas-Fittings Manufacturers,

EDINBURGH, AND

2, KING EDWARD STREET,

NEWGATE STREET, LONDON.

Meter Works in London—2, CROSS STREET, WILDERNESS ROW, E.C.

STATION-METERS GOVERNORS, CONSUMERS METERS, GAS LUSTRES, CHANDELIERS, BRACKETS, &c.,

And every description of Gas-Fittings and Gas Apparatus.

J. & J. BRADDOCK,

GAS ENGINEERS,

GLOBE METER-WORKS, OLDHAM,

MANUFACTURERS OF

WET & DRY CONSUMERS GAS-METERS,

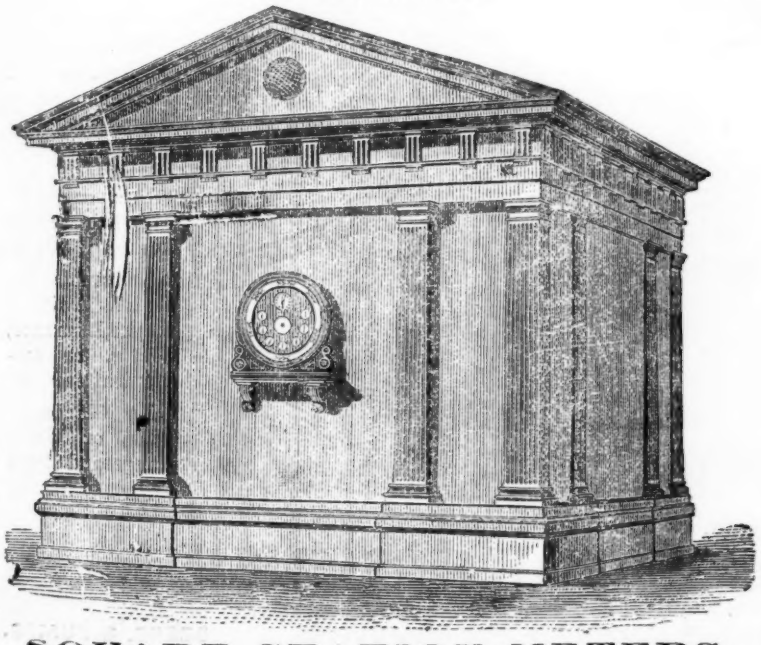
OF THE HIGHEST EXCELLENCE ONLY;

ALSO LICENSEES AND MANUFACTURERS OF

WARNER & COWAN'S PATENT SELF-REGULATING GAS-METERS;

ROUND STATION-METERS,

ON CAST-IRON STANDS.



SQUARE STATION-METERS,

WITH PLANED JOINTS

GOVERNORS, GAUGES, INDICATORS, MAIN COCKS, &c.

GAS COOKING APPARATUS.

Home and Foreign Orders promptly attended to.

All Sizes of **CONSUMERS METERS, STATION-METERS, and GOVERNORS** generally in Stock.

Orders almost invariably despatched on the day of receipt.

TERMS, &c. ON APPLICATION.

C. & W. WALKER'S

WOOD PURIFIER SIEVES,

Which have now been used for fifteen years, and their advantages and durability fully established. They are made entirely by steam machinery in very large quantities at the most moderate cost.

MIDLAND IRON-WORKS,
DONNINGTON, NEAR NEWPORT, SHROPSHIRE,
FINSBURY CIRCUS, LONDON.

ESTABLISHED IN 1860.

BENJAMIN CARPENTER,

THE ORIGINAL MANUFACTURER OF THE IMPROVED

WOOD SIEVES

FOR

GAS PURIFIERS & SCRUBBERS.

PROVIDENCE WORKS,
22, HERMES STREET, PENTONVILLE ROAD,
LONDON, N.

The Dunston Engine Works Co.,

GATESHEAD-UPON-TYNE.

Are the Sole Manufacturers of

Archer's Patent Hoists,

ALSO OF

Archer's Patent Stone Breaker, &c., &c.,

(As supplied to Sir Wm. Geo. Armstrong, C.B.),

AND OF

Archer's Patent Ore Crusher & Pulveriser,

Unequalled for the purposes of Mine Owners, Chemical Manufacturers, Cement Manufacturers, and others.

GRIRDROD'S PATENT

PORTABLE PIPE SCREWING MACHINE,

For 1 in., 1¼ in., 1½ in., and 2 in. Gas Threads, complete £7 10s.

In use at the chief gas-works, and giving great a tisfaction.

For other useful goods, see Bailey's "Illustrated Inventions," post free 3s. 6d.; gratis to ledger customers.

W. H. BAILEY & CO.,

Brassfounders, Gauge Injector and Tool Makers,
ALBION WORKS, SALFORD,
LANCASHIRE.

Gold Medal Awarded, Paris Exhibition, 1878.

THOMAS TURTON AND SONS,

SHEAF AND SPRING WORKS,

SHEFFIELD,

MANUFACTURERS OF

FILES OF BEST QUALITY

FOR ENGINEERS,

STEEL OF ALL DESCRIPTIONS,

SCREW STOCKS, TAPS, AND DIES, SPANNERS,
RATCHET BRACES, LIFTING-JACKS,
ANVILS, VICES,
AND ENGINEERS TOOLS GENERALLY.

LONDON OFFICE:

90, CANNON STREET, E.C.

R. W. WINFIELD AND CO.,

CAMBRIDGE STREET WORKS AND ROLLING MILLS.

BIRMINGHAM.

The following Medals have been awarded:—

GRAND COUNCIL MEDAL, LONDON, 1851. MEDAL, LONDON, 1862. GOLD MEDAL, PARIS, 1867,

The only Gold Medal awarded for "Apparatus and Processes for Heating and Lighting" by the Imperial Commissioners

MEDAL FOR PROGRESS, VIENNA, 1873.

The following Medals were also awarded at Paris, 1878:—

GOLD MEDAL for Chandeliers and Gas-Fittings.

GOLD MEDAL (Rappel) for Metallic Bedsteads and Furniture.

GOLD MEDAL (Rappel) for Art Metal Work. BRONZE MEDAL for Tube Metal and Wire.

MANUFACTURERS OF BRASS AND COPPER SHEETS,

TUBE AND WIRE,

ROLLED METALS, LOCOMOTIVE AND CONDENSER TUBES, CYLINDERS;

Ornamental, Taper, and Cased Tubes; Tin Tubes;

GAS-FITTINGS, CHANDELIERS,

BRACKETS FOR HEATING AND LIGHTING;

METALLIC BEDSTEADS.

Ecclesiastical and Mediæval Metal Workers.

GENERAL BRASSFOUNDERS.

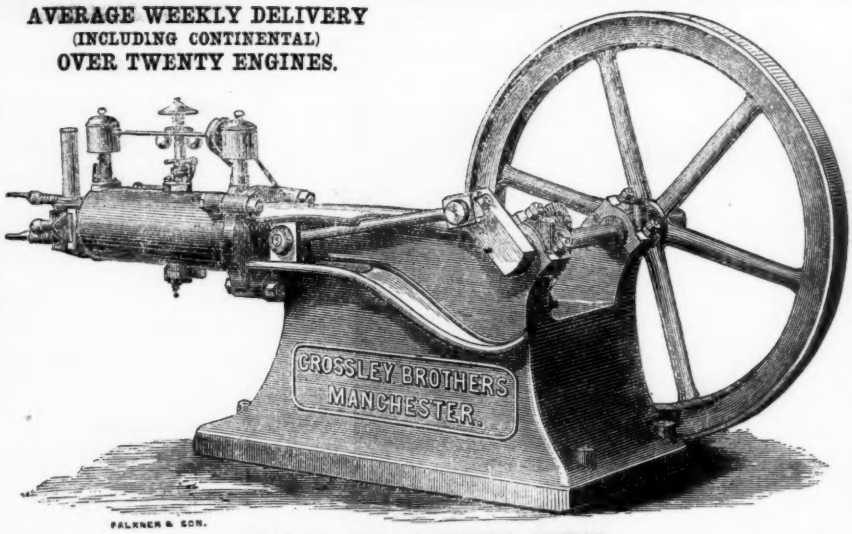
REGISTERED TRADE MARK:
R. W. W. & CO.

LONDON OFFICES & SHOW-ROOMS: 141, FLEET STREET, E.C.

AN ENGINE WHICH WORKS WITHOUT A BOILER OR STEAM

AVERAGE WEEKLY DELIVERY
(INCLUDING CONTINENTAL)
OVER TWENTY ENGINES.

The durability of these Engines is now established by experience, one of them having run night and day at the Hinckley Gas-Works for over Twelve months without any expenditure for repair; this being equal to about 2½ years average work.



FALKNER & SON.

Over 1900 already delivered.

Very numerous Testimonials from Users, including Engineers, Men of Science, and others, on application to the makers.

No trouble with Coal, Ashes, Smoke, Insurance, Water, or constant attendance.

No Glands to pack, or Water Gauges and Steam Gauges to watch.

STARTS AT A MOMENT'S NOTICE.

THE "OTTO" SILENT GAS-ENGINE.

(Otto and Crossley's Patents, 1876 and 1877,)

THEY ARE USED FOR ALL KINDS OF PURPOSES, CHIEFLY FOR EXHAUSTERS, SCRUBBERS, & PUMPS.

DELIVERED IN MANCHESTER.	SIZES									OFFERED.	CASES NOT CHARGED IF RETURNED FREE
	NOMINAL HORSE POWER	½	1	2	3½	6	8	12	16		
	MAXIMUM HORSE POWER	¾	1½	2½	4	9	12	18	24		

PRICES INCLUDE CAST-IRON STAND, TURNED FLY-WHEEL, AND DRIVING PULLEY; WATER-VESSEL, SEVERAL DUPLICATES, AND GAS-FITTINGS (EXCEPTING METER AND PIPES).

WORKS AND HEAD OFFICES:
Gt. Marlbro' St., Gloster St.

CROSSLEY BROTHERS,

MANCHESTER.

LONDON HOUSE:
116, Queen Victoria St., E.C.

TANGYE BROTHERS AND HOLMAN,

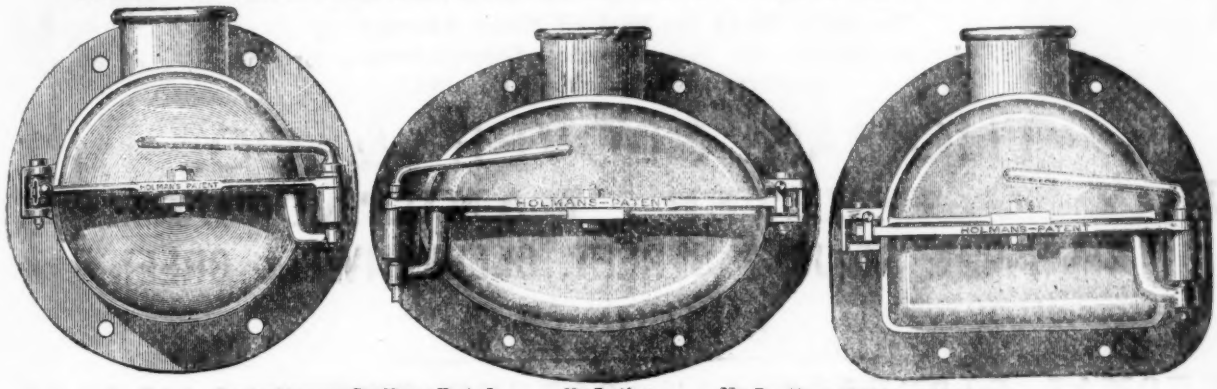
CORNWALL HOUSE, 35, QUEEN VICTORIA STREET, LONDON, E.C.,

(LATE OF 10, LAURENCE POUNTNEY LANE.)

SOLE MAKERS OF MORTON'S PATENT SELF-SEALING RETORT-LIDS.

WITH HOLMAN'S PATENT ECCENTRIC FASTENINGS,

Anti-Friction Catches, and New Self-Adjusting Cross-Bars.



Instantaneous Sealing effected. No Luting. No Duplicate Lids required.

Holman's New Self-Sustaining Cross-Bar ensures freedom of Joint, and maintains parallel position of the Lids.

Since their introduction in 1869, these Patent Retort-Lids have been thoroughly itested, being now in use in nearly all the principal Gas-Works in London and the Provnces.

T. B. and H. are now making the "Morton's Self-Sealing Lid" of the SAME FORM OR SECTION AS THE RETORT (see Illustrations above), as well as bringing the Mouthpiece from the D or Oval at back to Circular in front, as heretofore.

D and Oval Morton's Lids are working satisfactorily both in this country, on the Continent, and in the United States of America. Among others they have been adopted by the following Gas-Works:—

The Gaslight Company's Works, Fulham; Ditto, Bromley-by-Bow; Ditto, King's Cross; Ditto, Shoreditch.
And also in the Gas-Works at Richmond, Maidstone, Gloucester, Glasgow, Portsea, Roubaix (France), The Hague (Holland

HUNT'S PATENT EQUILIBRIUM GAS-GOVERNOR.

In this Governor a Throttle-Valve is substituted for the ordinary suspended Cone, all external communications being avoided by placing the Lever or Radius Arm (shown in the drawing) inside the Valve-Chamber upon the Disc. The Disc is carried upon steel centres, upon which it is accurately balanced and turns freely. The friction in working is thereby reduced to a minimum. This Governor is extremely sensitive to alterations of inlet or outlet pressure, and renders a large actuating holder unnecessary.

The principal advantages of this arrangement over the ordinary form of Governor are as follows:—

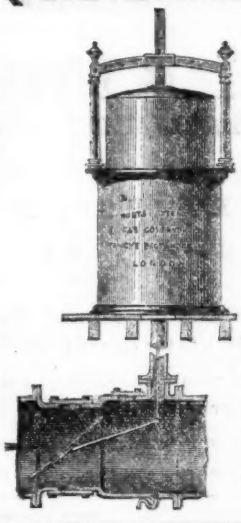
Its sensitive action prevents oscillation.

It is self-adjusting—*i.e.*, it maintains a steady pressure under variations of inlet pressure or a fluctuating consumption.

The inlet to Gasholder being contracted to the smallest possible dimensions, all danger from leakage through insufficiency of seal, tilting, &c., is entirely avoided.

The valve portion being separate from the holder, it can be handled and fixed like an ordinary Slide-Valve direct in the main; and the holder can be placed at an convenient distance immediately above it. The cost is thus materially reduced, and the inconvenience of heavy lifts done away with.

There are no working parts likely to get out of order.



These Governors have been adopted by many leading Gas Companies, among whom are the following:—

The Gaslight and Coke Co. (9). The London Gas Co. (3), and at Abergavenny, Arundel, Birmingham. Cannes (France), Devonport, Dursley, Exeter, Guernsey, Halesowen, Mentone (France), Monmouth, Newcastle-on-Tyne, Oxford, Plymouth, Rochdale, Windsor, &c.

TESTIMONIAL.

The Gaslight and Coke Company,
9, Water Street, New Bridge Street,
Blackfriars, E.C., Feb. 27, 1878.

MESSRS. TANGYE BROTHERS AND HOLMAN.

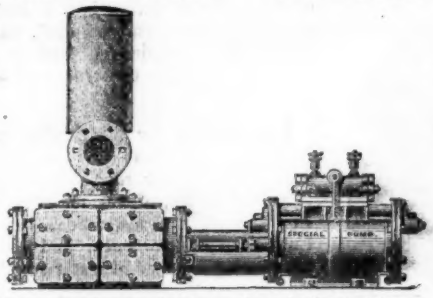
Gentlemen,—The two 24-inch and three 36-inch Hunt's Equilibrium Governors supplied by you, and fixed in the valve-rooms at Whitechapel, Goswell Road, and Blackfriars, are working very satisfactorily.

Yours truly,
(Signed) JOHN JOHNSON.

PRICES AND FULL PARTICULARS ON APPLICATION.

THE "SPECIAL" STEAM-PUMP.

Diameter of Steam Cylinder.	Diameter of Water Cylinder.	Length of Stroke.	Gallons of Water per Hour, Approximate.	Reduced Prices.
3	1½	9	450	£16
4	2	9	815	18
5*	2½	12	1,250*	21
5*	3	12	1,880*	22 10
4	4	12	3,250	25
6*	4	12	3,250*	30
5	5	12	5,070	32 10
7*	5	12	5,070*	40
6	6	12	7,330	40
8*	6	12	7,330*	50
7	7	12	9,750	50
10*	7	12	9,750*	65



In use in a Hundred Gas-Works in the United Kingdom for Pumping Ammoniacal Liquor, Water, or Tar.

Messrs. Burt, Boulton, and Haywood, Manufacturing Chemists, have over FORTY "Special" Steam-Pumps in use at their several large Tar-Works.

Two Hundred Sizes made. Those in Table opposite are the leading Sizes for use in Gas-Works and Chemical Works.

* These Sizes being usually selected for pumping Tar and Liquor, are always in stock, or nearly ready, fitted with all pump details in iron, and extra length distance-piece between steam and pump cylinder, at a small extra cost.

TANGYE'S HIGH-PRESSURE AND CONDENSING STEAM-ENGINES; CORNISH, VERTICAL, & TUBULAR BOILERS; HYDRAULIC AND SCREW LIFTING-JACKS, CRABS, PULLEY-BLOCKS, &c.

FULL PARTICULARS, ESTIMATES, CATALOGUES, ETC., ON APPLICATION.

London, 1851. New York, 1853. Paris, 1855. London, 1862.

Dublin, 1865.

The SIX MEDALS AWARDED to THOMAS GLOVER for

PATENT DRY GAS-METERS,

The latter being the Highest Medal awarded for Dry Gas-Meters bv the Imperial Commissioners for the Universal Exhibition, Paris, 1867.

Paris, 1867.

THOMAS GLOVER & CO.,

DRY GAS-METER MANUFACTURERS,

214 TO 222, ST. JOHN STREET, CLERKENWELL GREEN,

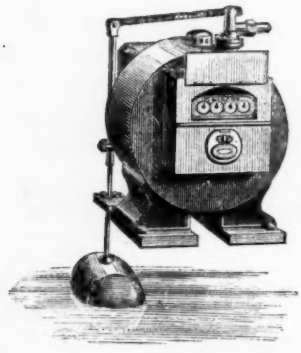
LONDON, E.C.

THOMAS GLOVER & CO.'S PATENT DRY GAS-METERS.

1st, Are a remedy for all the defects of Wet Meters;
2nd, Are suitable for all climates, whether hot or cold;
3rd, Incur no loss of Gas by evaporation;
4th, Cannot become fixed by frost, however severe;
5th, Are the most accurate and unvarying measurers of Gas;
6th, Prevent jumping or unexpected extinction of the Lights;
7th, May be fixed either above or below the level of the Lights;
8th, Cannot be tampered with, without visibly damaging the outer case;
9th, Will last much longer than Wet Meters;
10th, Will not cost more than one-half for repair that Wet or Water Meters do;
Are upheld for five years without charge.

WILLIAM PARKINSON AND CO.

(ESTABLISHED 1816.)



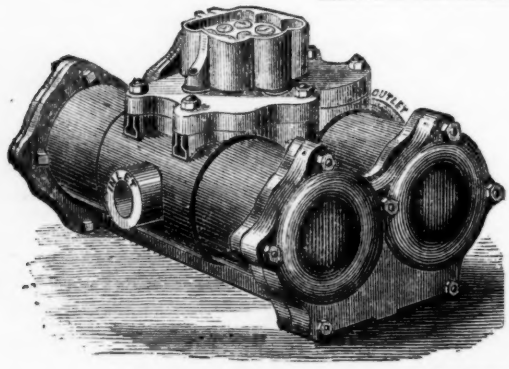
SOLE MAKERS OF THE LOW-PRESSURE WATER-METER.

This Meter will register with perfect accuracy, either at full speed, or with a few drops only passing through it.

It must be placed over the cistern to be supplied, and the water, after being measured, will fall from the outlet into the cistern below.

Each Meter is fitted with a ball-valve, so made that it can be adjusted to shut off the supply at the inlet when the water reaches any required height in the cistern.

The 100-gallon Meter is fitted with a cistern holding about three or four gallons, and may be fixed inside a house, free from the effects of frost, and requires no attention after once being fixed.



HIGH-PRESSURE WATER-METER.

The Union Water-Meter, of which an external view is here given, is of the positive class—*i.e.*, a Meter in which a measuring chamber is alternately filled and emptied, each filling being duly recorded. It is formed of two cylinders, with double pistons in each, having a rotary-valve of peculiar construction, which is worked from cams on the piston-rods.

It is claimed for this Meter, among its advantages over other Piston Meters in use, that it is extremely small and compact, and that its durability and accuracy have been proved by the fact that upwards of 20,000 of them, of various sizes, are in successful operation in the States. In England the instrument has been fully tested by several Water Engineers of eminence, and pronounced by them as a reliable and satisfactory register of water supply; it is also economical in cost.

ALL METERS are TESTED with 60 lbs. pressure before they are sent out.

COTTAGE LANE, CITY ROAD, LONDON, E.C.

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TO CORRESPONDENTS.

No notice can be taken of anonymous communications. Whatever is intended for insertion, must be authenticated by the name and address of the writer; not necessarily for publication, but as a guarantee of good faith.

THE JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, JUNE 24, 1879.

Circular to Gas Companies.

THE great sale of stock of The Gaslight and Coke Company duly came off on Thursday last. There was no excitement such as was displayed when the late Mr. Brushfield's gas property was sold some three years and a half ago; but there was a large attendance of gentlemen, evidently intent on investing on terms which would suit their books. The key-note was struck when a bidder offered £180 for the two first lots of £100 each; but the orchestra, as we may call the body of investors, did not keep up to the pitch, and succeeding lots fetched somewhat lower prices —£178½ and £177¾. When lots of larger nominal value were offered, biddings went still lower, and the first series of £500 lots fetched £177, £176¼, and £176. When the £1000 lots were offered, the bidding further declined, and the fact was brought out that the reserve price put upon the stock was £175. Several of these lots remain unsold. When the £2000 lots were reached, an enterprising firm of stockbrokers, we believe, took the first five at £175, and a gentleman took another lot at the same price. After this explosion the biddings collapsed, and for the remaining lots no offers were made. The next series were lots of £100 each, and competition became more active, £176¼ to £177 being realized. At these prices the whole of the second series of £100 lots were disposed of. When the next series—£500 lots—was reached, it had become clear that lots of £100 each brought the highest prices, and it was very wisely resolved to allow investors to bid for £100, and take as many hundreds as they pleased. About the same prices continued to be realized through the next series of £1000 and £2000 lots; but the biddings gradually fell off until they nearly reached the reserved price. A fitful quarter was occasionally added to the £175, but it soon became apparent that nothing in advance of this price would be realized, and on reaching Lot 99 the sale was stopped for want of bidders. A few hundreds might have been disposed of afterwards; but, as no advance was likely to be made beyond £175, it was as well, perhaps, to close the auction. The result cannot be deemed entirely unsatisfactory. It was complained, in the room, that the reserve was fixed too high; but it appears to have been fully justified by the present market value of the stock of the Company. Of the stock of £100,000 nominal value, £64,500 was sold, realizing premiums to the amount of £48,610, making a total of £113,110. The average price fetched was £175 7s. 3d. The sum realized will, no doubt, be sufficient for the Company for some time to come. But they have a further chance; the unsold stock must be offered to existing proprietors at the reserved price, and we shall wait with some curiosity to see how much is taken up by them. In all probability, another auction will be necessary in the course of a year or so, when the aspect of affairs may be somewhat changed. It is likely that a considerable amount of this stock was bought by speculators, who will throw it on the market, and it will be interesting to note the effect that will be produced on the price of the ordinary stock of the Company. That it will rise in value can hardly be anticipated; but we can see no reason why the smallest depreciation should take place.

There is no disguising the fact that, for the purposes of external illumination, the Jablochkoff system of electric lighting continues to make progress. Circuits of great length, it is now shown, are possible, and candles of three hours duration are at the present time in use. There is a further improvement, which is of great importance, and that is an automatic switch, by means of which, when one candle is burnt out, the current is passed on to another, so that, if it be desired, six candles can be placed in the lantern, and a continuous light maintained for eighteen hours. The long circuits which it is now shown are possible, constitute an innovation which is of great importance, for it would seem feasible to illuminate all the great railway termini in London from a central station near Charing Cross. This is, however, of little consequence to us. We have repeatedly said that it will be long years before the electric light invades our houses and ordinary shops. In these, gas will reign supreme for a generation or two. But it is useless to shut our eyes to the established facts, and it seems possible that before long a part of the public lighting will pass from the hands of Gas Companies. Street lighting they might be glad to get rid of; but the same could hardly be said of the illumination of our railway stations, which is, at present, profitable.

We commence to-day the publication of the papers read before the British Association of Gas Managers, and the discussions which took place thereon. The first paper read was one by Mr. W. Cowan, of Edinburgh, giving a description of his "Automatic Pressure Changer" for station-governors. This apparatus, though somewhat complicated in appearance on a cursory glance, is really simple in character, and performs the operations of increasing and reducing the pressure with the utmost exactitude, as was shown by the inventor during the intervals in the meetings. No higher testimony to its usefulness could be adduced than that borne by Mr. Corbet Woodall, who stated that it had been for a few months in operation at one of the stations of the Phœnix Gas Company, where it had, during the whole period, acted with unfailing regularity. It appears to us that such an instrument, admitting as it does of dispensing with the attendant to do the important work which it performs, must be of great usefulness and value. Its utility in *reducing* the initial pressure at the stated intervals during the later hours of the night, in the absence of the Manager, is alone sufficient to recommend its extensive adoption.

Mr. Travers, of Cork, returned again to the question—"How "can Companies best promote the Use of Gas for Heating "Purposes?" The employment of gas for this purpose is very rapidly extending, and many more stoves would be employed if gas were cheaper. He showed that, with gas at 4s. per thousand, that the margin of advantage to the consumer of its employment, as against coal, is very small. We find, however, as a matter of fact, that gas-stoves are in common use where the price of the fuel is considerably above 4s. Mr. Travers's suggestion,

that all stoves in use during the day should have a separate connection and a separate meter, deserves attention.

In another column will be found a short paper from a Danish correspondent, on the "Successful Management of Gas-Works." In the little town of Nakskov, containing 500 inhabited houses within reach of the mains, and with gas at 4s. 5d. per thousand for lighting, and 3s. 4d. for cooking, the use of gas for the latter purpose appears to be considerable. The differential charge for what we may call the day and night consumption is worthy of remark. We cannot suppose that two different kinds of gas are supplied, so we may take it that the Municipality offer a sort of premium to day consumers. We fear that any arrangement of this kind is impossible in this country, and for an increased consumption we must look to a reduction of price all through the twenty-four hours.

Returning, however, to Mr. Travers, we commend his earnest endeavours to promote the consumption of gas. In the discussion which ensued, Mr. Travers's suggestion of a double service was generally supported, but some experienced Managers dissented. We cannot help thinking, however, that Mr. Travers is right. A separate service may not be needed when only a small apparatus is used, but when stoves are put up for establishments of considerable size, we may take it a distinct service is absolutely necessary for economy. Other practical points will be noted, especially one recommending frequent inspection by the Company's officers, to see that the burners are in order. The necessity should be noted of persuading masters and mistresses to keep an eye on their servants doings. How advisable this is, was illustrated by the stories related by different speakers in the course of the discussion.

Mr. W. Sugg is an eminently practical man, who has given much attention to the electric light and its aspect as a competitor with gas. Consequently, the paper he read on "Lighting by "Gas and Electricity" was listened to with great attention. After a very careful study of the question in all its bearings, the conclusion at which Mr. Sugg has arrived is, that gas can well hold its own against electricity as an illuminating agent. All our readers, we are certain, will peruse Mr. Sugg's paper with care, and therefore no comments are necessary. The discussion which followed showed the great interest which gas managers take in the question, and how they draw the natural deduction which is to be made. They see clearly that for gas to retain its supremacy, improvements are required in several directions. Mr. Sugg has furnished us with improved lamps and burners of great power; but they are expensive, and few parishes will adopt them. This will teach the Managers and Directors of Gas Companies the necessity of producing gas at as low a price as possible. Perhaps no great changes in the cost of production can be effected, but it is generally admitted that there is room for economical improvements, which will, in time, doubtless be made. Mr. Sugg received the hearty thanks of the meeting for putting before them a rather abstruse subject in a lucid manner.

The report of the Select Committee on Lighting by Electricity appears to have fallen rather flat on the profession and the public. This is not to be wondered at, seeing its vague and indefinite character; and yet perhaps the Committee have said all that could have been uttered on the subject. Everybody knows "that the electric light is produced by the transformation "of energy either through chemical or mechanical means." From what the energy is derived is, at the present moment, of little importance. A gas-engine answers well when only a few lights are wanted; but very powerful steam-engines must be employed when a number of lights of great intensity are required on a long circuit; and if electricity should ever become a general illuminating agent, very powerful motive force indeed will be necessary. We have to admit the fact, that the light has made so much progress that it has established itself as a means of illuminating open spaces of large area, also large symmetrical interiors. Since this report was published, however, a step in advance seems to have been made. Mr. Werdermann has lighted the library of the South Kensington Museum with much success, though he laboured under some difficulties. The magneto-electric machine which he employed on the occasion is said to have been a Gramme of the oldest pattern, and much worn. It was driven by an Otto-Crossley engine of eight-horse power, consuming 250 cubic feet of gas per hour. The number of Argand burners superseded by the eight Werdermann lamps is thirty, consuming 150 cubic feet per hour, so that at present no economy is found to result from the use of the electric light. The interest of the experiment lies in this, that here for the first time the electric light has been employed to illuminate small internal spaces. Much will be made of this by the enemies of Gas Companies. We may take it as a fact that Mr. Werdermann could, on his system, light up every room in a moderate-sized house; but, as will be seen, nothing could be gained by this on the score of economy. To light one room requires the exercise of as much energy as would be necessary to light the whole house. So long as no discovery is made that will enable people to shut off electricity as they can now shut off gas, so long will electricity be kept out of our houses. Of course there is no difficulty in extinguishing one light after another; but then, as we have said, the same amount of energy will be required to light the last as would have sufficed for the whole series. We are bound, however, to admit that Mr. Werdermann has made a step forward, and if the successful use of his system in small interiors stimulates Gas Managers in the way it should, as was suggested at Newcastle, we shall not be inclined to envy his success.

To return, however, to the report of the Select Committee. It is admitted that, so far, the electric light has not established itself as an economic light in comparison with gas. This is a large admission from such a body as the Committee on Lighting by Electricity, but it was inevitable. It is really not necessary to notice the latter part of the report, which deals with the question of legislative interference, except so far as relates to remarks on Gas Companies. These do not make any special claim to be considered as the future distributors of the electric light, but simply ask for a fair field and no favour. Should it ever be made possible to light up great lengths of streets, railway stations, and what not, by electricity, no persons are in such a good position to supply the force as Gas Companies. And they have ready at hand everything necessary, except dynamo-electric machines and cables. These, however, could easily be obtained, and any Gas Company could light up, if necessary, a large district in a very short space of time. We have before alluded to the spiteful remark, that in the hands of Gas Companies the electric light would be but slowly developed. The sarcasm insinuated was perfectly gratuitous. If ever electricity should prove a serious opponent to Gas Companies, none would go more earnestly into the business than they. They may, however, be content to wait, for at present there is little to indicate that any serious competition is possible.

The Gas Consumers of Stretford have held an indignation meeting to protest against the exorbitant charges of the Gas Company. The allegation is, first of all, that the price of gas is much too high; next that, by the wrongful registration of meters, consumers are charged for a much larger quantity of gas than they have actually burned; thirdly, that the Company charge for service-pipes which, by their Act of Parliament, they are compelled to lay up to the consumer's house free of cost. The first of the allegations is answered by the fact that the Company are about to reduce the price fivepence per thousand feet. As regards the second, no satisfactory answer appears to have been given. The Company take the register of the meters as *primâ facie* evidence of the quantity of gas consumed, and make out their bills accordingly; but it seems that they do occasionally take off a portion of the charge. We pay no attention to the gentleman who locked up his house for three months, and when he returned home found he had a gas bill to pay. Next time he leaves his house for so long a period, we hope he will send to the Company and have his meter disconnected. Whatever foundation there may be for complaints of registration, which obtain all over the kingdom, it would be well for Companies to give each case careful consideration. We can hardly accept the words of the speakers at the meeting as to the charges made for service-pipes; but they evidently have a grievance which should be looked into. Opposition works are threatened at Stretford; but, of course, no such competition is possible.

We have received from the Borough Accountant—Mr. John Hamer—a neat octavo volume of 474 pages, which contains an abstract of the accounts of the Corporation of Bradford for the past year. It is a wilderness of figures; but just as the Red American Indian can thread his way through the densest forest to his domestic wigwam, so we have no doubt a skilled accountant, and possibly a Town Councillor of Bradford, may be able to find his way to a perfect comprehension of these elaborate accounts. Happily we have only to do with those relating to gas, which occupy thirty-two pages. From them we gather that the expenditure for working and maintenance was £114,763, while the receipts amounted to £168,076, showing a gross profit of £53,313. Out of this it seems that £20,000 has been appropriated to the borough fund. After sundry charges are deducted, and a sum brought forward from 1877, there appears to remain a balance of £28,151. We regard it as unfortunate that no working statement is to be found in these accounts. Coal and cannel cost the Corporation £44,944, but we are not told how much gas was produced. As regards residuals, we find that coke brought £8934; tar, £9288; and ammoniacal liquor, £5654; making a total of nearly £23,876.

We cannot help wishing that Bradford, like Nottingham and some other Corporations, would give us their gas accounts in the simple form prescribed for the London Companies, or the equally simple system invented by Mr. Lass. There can be no difficulty in adapting these forms to the peculiarities of Municipal undertakings. Perhaps we ought to mention that the amount of capital at present invested in the undertaking is £371,465, and that the original cost of the works to the Corporation in 1871 was £210,000.

Water and Sanitary Notes.

Opposition to the Indemnity Bill of the Metropolitan Board of Works has sprung up in a quarter from which we did not expect it. The Vestries having practically withdrawn their opposition, and the Corporation of the City of London having declined to enter into a crusade against it, we thought the Bill was certain to pass through by easy stages; but suddenly Mr. Raikes appears, we take it, only in his capacity as a private member, and has put a notice on the paper, that on the second reading of the Bill he will move that no measure of the kind should be entertained by the House unless it is brought in by the Government on their own responsibility. This is a severe blow for the Metropolitan Board, for if Mr. Raikes should succeed in carrying his motion, it is clear that the Board have little to hope for from Government assistance. The session is now so far advanced, and Government business is so much behind, that we cannot expect them to introduce any measure which is not likely to be carried without discussion. It is true that in a question of this kind the Irish obstructives are not likely to interfere, so Mr. Cross may possibly be induced to promote a measure which will save the members of the Board from a surcharge of about £400 each.

How a water undertaking grows in a populous and extending district is well illustrated by the history of the Liverpool undertaking. In 1861 the works brought a revenue to the Corporation of £7337, while for the past year the water-rents produced £193,473, the expenditure having been £162,642. A sum of £22,356 has been carried to a depreciation-fund, which leaves a considerable balance. Large amounts have been expended on works. The Green Lanes extensions have cost £448,755, including £7722 expended during last year. Upwards of £6000 have been spent on deep boring, which, so far as we know, has been completely unproductive. We gather from the paper we quote from, but do not guarantee the figures, that the present water debt of the Corporation amounts to £2,302,954, of which nearly a million and a quarter have been spent on the Rivington works; "and yet," says a local contemporary, plaintively, "we "must go somewhere else to look for water." Yes, and at their last meeting the Water Committee, by the casting vote of the Chairman, recommended the Council to proceed with the Vyrnwy scheme, which will cost more than another million. A deputation from the Manchester Corporation attended the meeting, in reference to sharing the supply from Thirlmere; but as separate culverts were insisted on, the Liverpool Committee declined to entertain the proposal. The decision of the Water Committee, especially with such a narrow majority, does not bind the Town Council, so that there is still a chance that another scheme, be it a supply from Haweswater or sharing the supply from Thirlmere, may eventually be adopted. When the Town Council next meet, we shall learn the views of the whole body on the subject. It is no doubt an extremely difficult matter to decide upon, but so much practical talent is to be found in the Council, that we cannot help thinking they will decide on the most economical and promising source of supply.

Cardinal Manning and his teetotal followers failed to obtain from the Home Secretary any assurance that the Government would take up the Metropolitan Water Question. It is impossible that they can do so, at all events at present. The authority which must have the control of the water supply has yet to be established, and no one seems to know how it shall be constituted. The Metropolitan Board of Works are altogether out of the running, and a Government Commission finds little favour in the eyes of the water agitators. In the meantime, it must be admitted that water of excellent quality and in more than sufficient quantity is supplied to London. Cardinal Manning and his followers assert that the condition of the water supply drives people to the public-houses. It is strange that while the teetotalers drink the water, and do not go to public-houses, others who have not taken the pledge cannot refrain from intoxicating liquors. We may freely grant that the receptacles for water, especially those used by the poorer classes, are filthy in the extreme. But whose fault is this? Clearly that of the inhabitants of the wretched tenements supplied. But the conditions, after all, are not so bad as they are represented to be. We recently saw a cistern emptied which had not been cleansed for many years, but the deposit of mud at the bottom was extremely small, and hardly worthy of notice. However, a bad excuse is better than none, and if it be the fact that working men go to public-houses because they have not pure water, the matter is deserving of serious attention. But their wives and children drink from the same source, and, although it must be admitted that the death-rate of children of the lower classes is much higher than that which obtains in the upper ranks, the reasons for this are not far to seek. It is overcrowding and bad feeding that do the mischief which is ascribed to water. There will be no possibility of reducing the death-rate among the lower classes until better dwellings are provided, and better habits induced. We note that during the week last reported on by the Registrar-General, the death-rate of London fell to 19·5 per thousand, which is extremely low. We must wait until next month to see what is Dr. Frankland's report of the condition of the water during this period of exceptionally low death-rate; but we may readily guess what that report will be.

The Vestry Delegates who met at St. Martin's are still active, and are once more about to memorialize Mr. Cross. At their last interview it will be remembered that the right honourable gentleman recommended the Delegates to come to terms with the Water Companies before they approached him again. The Delegates, however, stand aghast at the suggestion. They know very well what would have to be paid for the water undertakings, and they do not see their way, first of all, to the constitution of a Board to take them over and manage them, and next to the mode of raising the money necessary for the purchase. It is all very well for Mr. Beal to suggest that a memorial should be drawn up, dealing with the financial part of the question; but who is in a position to draw up such a memorial? The Home Secretary is to be recommended to invite the Water Companies to state their views on the matter; but the views of the Delegates and the Water Companies, we are certain, will not be in accordance. The latter know their strength, and will not yield to ordinary pressure. Nothing but the intervention of a strong Government will induce the Companies to part with their property, and then the terms that will be arranged will, we think, startle the Vestry Delegates. We are sorry that we observed no disposition on the part of the Water Companies to come to terms with each other, in effecting an amalgamation which would, we believe, satisfy all the opponents who are now seeking to overthrow their interests.

The new water-works for the supply of Edinburgh and neighbourhood, known as the Moorfoot scheme, were formally opened on the 13th inst. These works are admirably adapted to fulfil the intentions of the promoters of the scheme. The most important feature is the Gladhouse reservoir, which covers an area of four hundred acres, and is calculated to hold one thousand seven hundred million gallons. It is sixty-eight feet deep, and an embankment had to be made proportioned to bear the enormous weight of water pressing against it. The work, however, has been accomplished with the most complete success, and there is no fear that the reservoir will imperil the inhabitants lower down. The entire system is not yet completed, the filtering-beds, &c., being unfinished, but at the present time sufficient water can be sent into Edinburgh to supply the population with thirty-nine gallons per head per day. When the whole system is in operation, a supply of fifty-two gallons per head per day will be obtainable. This is a far larger quantity than can possibly be required. The bulk of it is certain to run to waste, and we would recommend the Edinburgh Water Trust to take steps to prevent a reckless misuse of what is really an expensive commodity.

The Lower Thames Valley Main Sewerage Board, having failed to obtain a second reading of the Bill they promoted in the House of Commons to enable them to carry out Lieut.-Col. Haywood's irrigation scheme at Molesey, have resolved to apply to the Local Government Board for a Provisional Order to empower them to do just what the House of Commons practically decided they should not be allowed to do. Of course, the same parties who opposed the Bill can oppose the Provisional Order, which will not be granted without an inquiry, which, in this case, will be long drawn out. It will be curious to see whether the fiat of a Government department can overrule a decisive vote of the House of Commons. But that is hardly the question. We have repeatedly said that the Bill ought to have been allowed to go before a Select Committee, who would have decided the case upon its merits. Now the inquiry will be held before an Inspector of the Local Government Board, whose report to the Central Authority will be final. It is not altogether a satisfactory state of affairs; but the Drainage Board are perfectly justified in taking the measures

which they think will best enable them to carry out their plans.

The opportunities the working man has of escaping the temptations of the public-house are very numerous. Just now he is invited by the National Health Society to attend a series of lectures on Elementary Sanitary Science. Plumbers are especially invited, and we express a strong wish that these would attend in large numbers. At the present time, a plumber in a house is simply a nuisance and a source of danger. If he can be induced to learn the elementary principles of sanitary science, he can be made an instrument of good work; but we fear he will remain contented with his skill in making a wiped joint, and continue to set at defiance all the principles of sanitary and even physical science. Nevertheless, the National Health Society deserve much credit for their endeavours to interest a class of men on whom, more than any others, the sanitary condition of our houses must depend.

THE SELECT COMMITTEE ON THE ELECTRIC LIGHT.

The report of the Select Committee of the House of Commons on Electric Lighting may be received as a document which is not likely to err on the side of antagonism to the new mode of illumination. Without saying that the Committee were at all blind to the faults of the electric light, we may suggest that they were at least kind to its virtues. As towards gas, the feeling was perhaps somewhat different, and we cannot but apprehend that the mode in which the inquiry was conducted scarcely admitted of a full hearing for what may be called the old light. It might be said that this was true of the evidence for the new light also. In all cases the Chairman of the Committee asked such questions as he thought fit, and it is quite possible that several things which witnesses desired to say were left unsaid. When a Select Committee have a Bill before them, both supported and opposed by counsel, the system of examination and cross-examination serves to bring out all the points. This valuable assistance is wanting when a Committee sit merely to conduct an inquiry. In the present instance, the Committee were naturally desirous to learn all that they could in respect to the electric light, and it is not likely that they would care to hear everything that might be said by a witness supposed to be connected with the Gas Companies. However, we need not quarrel with the issue. It is well that the new candidate should have the best possible chance. A fair opportunity has been given to the advocates of the electric light to say what they can in its behalf, and we may consider that they stated their case to willing ears, so that no injustice has been done to their side of the question.

On these grounds we feel justified in saying that the report of the Committee may be held to state the case as favourably as it can be stated on behalf of the electric light. In that respect nothing can be added to the report, except it be that, since the inquiry closed, experiments have been conducted which show that the electric currents can be carried to a greater distance than was formerly thought practicable. Looking, therefore, into this official document, in order to see how far the electric light has proved successful, we find it stated that, "Compared with gas, "the economy for equal illumination does not yet appear to be "conclusively established." The Committee say that, although in some cases the relative economy for equal candle power is on the side of the electric light, "yet in other cases gas illumination "of equal intensity has the advantage." Hence we are told that "unquestionably the electric light has not made that progress "which would enable it, in its present condition, to enter into "general competition with gas for the ordinary purposes of "domestic supply." "So far as we have received evidence," say the Committee, "no system of central origin and distribu-"tion suitable to houses of moderate size has hitherto been "established."

It will thus be seen how far the electric light falls short of the sanguine expectations entertained in some quarters a few months ago. Admitting that the electric light is in a progressive stage, there is yet no definite promise as to the future. It has proved itself available for lighthouse illumination, though we believe even there it is not wholly relied upon, some other mode of illumination being kept in reserve, in case the electric apparatus should fail. The Committee also say the light is "fitted to "illumine large symmetrical places, such as squares, public halls, "railway stations, and workshops." We are also told that, "Many trials have been made for street illumination, with greater "or less success." The Holborn Viaduct, we presume, is not a case in point, nor even Mr. Hollingshead's display outside the Gaiety. The Committee might have said that the electric light has been tried out of doors in certain cases, and has proved "more or less of a failure;" but they do not say this. Mr. Keates very clearly shows that the electric light on the Victoria Embankment costs nearly sixpence per hour per lamp, while equivalent light from gas would cost only twopence, or, if a frosted instead of the opal globe were used for the electric light, the equivalent of gas would be threepence halfpenny. The present charge for the electric light on the Embankment is fivepence per lamp per hour, but the Metropolitan Board have also to pay for the hire of the engine.

The Select Committee lay considerable stress on certain statements as to the "transformation of energy." On this point they received evidence from Sir William Thomson, Dr. Siemens, and Mr. Hopkinson. In our report of the evidence given before the Committee, Sir William appears as saying: "The "energy which is actually used in the production of the electric "arc is about one-horse power per two thousand four hundred, "or even more, candle power, according to the dimensions and "other circumstances of the electric arc. One-horse power of "energy in the combustion of gas produces about twelve-candle "power." We believe this is really what Sir William said. In the report of the Select Committee, the question takes the following form:—"A remarkable feature of the electric light is "that it produces a transformation of energy in a singularly "complete manner. Thus the energy of one-horse power may "be converted into gaslight, and yields a luminosity equal "to twelve-candle power. But the same amount of energy "transformed into the electric light, produces one thousand "six hundred-candle power." Referring again to the evidence given before the Committee, we find Sir William replying to Lord Lindsay: "With regard to what I said as to the two "thousand four hundred-candle electric light being produced "by one-horse power, that would be one-horse power net, "after taking off what is required for the friction and heating "of the machine." In order to give as accurate a view as possible of what Sir William really intended to say, we quote another passage in his evidence. After stating that in one experiment he made use of a very feeble electric light produced by a battery, Sir William went on to say: "I have made "several measurements, with the assistance of Professor Tait, "upon a much more powerful electric light produced by a "Gramme machine driven by a gas-engine. Allowing the "practical estimate of one-horse power actually spent in driving "the engine to produce one thousand two hundred candles, "which has been realized, I estimate that one-half of the power "goes to the electric arc, and one-half is lost in heating different "parts of the machine. This, then, gives two thousand four "hundred candles per one-horse power."

We must say this appears rather a lame way of making up the candle power of the electric light. To our mind it entirely fails to justify the statement in the report, which declares—"A "remarkable feature of the electric light is that it produces a "transformation of energy in a singularly complete manner." According to Sir William Thomson, "one-half the energy is "lost in heating different parts of the machine." How, then, can it be said that the electric "light" exhibits a "complete "transformation of energy?" The completeness extends to one-half, the other half giving no luminosity. At the utmost, the one-horse power applied to the production of the electric light is equal to 1200 candles, according to the evidence of Sir William Thomson, while the Committee put it up to 1600 candles. To make matters still worse, it is stated, on the authority of the same gentleman, that the energy of one-horse power converted into gaslight is only equal to twelve candles. According to his own mode of dealing with the problem, Sir William may be right. But we venture to propose another kind of calculation, which at least possesses the advantage of being plain and practical. We take a ton of coal as capable of producing, by its distillation in a retort, as much as 10,000 cubic feet of sixteen-candle gas. Of course, to do this, the coal must contain a certain proportion of cannel, which, in the case of one London Company, is about nine per cent. In reality, the gas has a lighting power exceeding sixteen candles, but of that we take no account. In the experiments on the Victoria Embankment, as reported by Sir J. Bazalgette and Mr. Keates, it appears that the consumption of coal per indicated horse power was four pounds per hour. For the nominal horse power the consumption of coal must have been higher, but we will simply take the four pounds. This quantity of coal will produce, in round numbers, eighteen feet of gas, equal to 57 candles per hour. But, as a matter of fact, more light could be obtained from the coal if the Companies saw fit to get all the light they could out of it. It is simply a question of economy, whether the coal should be converted as far as possible into gas, or whether the process should stop at a certain point. Some of our readers will remember the process devised by Dr.

Eveleigh, which led to the establishment, for a time, of the Patent Gas Company. Dr. Eveleigh's plan was to use up not only the coal, but also the tar, in the production of gas, and in that way he obtained a large additional amount of candle power from a given quantity of coal. Economically the plan did not answer, and it might be almost literally said that "the game was "not worth the candle."

The fallacy of the comparison made between the candle power of gas and the electric light is thus apparent, when we consider that in the manufacture of gas there is a large amount of "energy" which takes the form of residual products. It might please a philosopher to convert all the energy in a pound of coal into gas; but a commercial enterprise differs somewhat from a scientific experiment, and shareholders require to see a certain amount of "energy" represented by dividends. The experiment must not only look pretty, it must also pay. If a gas company were compelled by Act of Parliament to get all the candle power they could out of their coal, without any regard to the value of the residual products, the directors would be obliged to charge a higher price for the gas. We can assure Dr. Playfair and Sir W. Thomson that "energy" is not lost when it takes the form of coke, breeze, tar, and ammoniacal liquor. When power is applied to the production of the electric light, the only marketable result is the light itself. The heat brings no money to the exchequer, though Sir W. Thomson has suggested that when the Niagara Falls are made to work dynamo-electric machines, the waste heat should be turned to account by creating a flow of hot water in the conducting tubes. This is something like "shooting Niagara," and we can only say: "What next?" Will a future generation be invited to take shares in the "Electric Light, Power, and Hot Water Company, Limited?"

In comparing the two lights, it should also be taken into consideration that, in producing the electric light, there is a consumption of carbon in the lamps as well as in the furnace of the engine, and the cost thus incurred has much to do with the financial result. Moreover, as a matter of fact, one-horse power, as applied to the electric lights on the Victoria Embankment, has barely given the light of 400 candles, subject to a further reduction owing to the use of opal or frosted globes.

Whatever may be in the womb of futurity with regard to the electric light, it is evident that at the present hour it is dearer than gas for the purpose of street illumination in London. This may not continue to be the case, and it is evident that every effort will be made to compete with gas on equal terms, and, if possible, even at a cheaper rate. But, while hopeful as to street lighting by electricity, Sir J. Bazalgette and Mr. Keates state at the close of their recent report that, as concerns the electric light, "at present there are defects connected with it "that must prevent its adoption as a general mode of lighting "competing with gas." "There is," say these authorities, "in "our opinion, no prospect at present of any such general com-"petition." It is difficult to know what value is to be attached to the words "at present." They seem to suggest a lurking expectation that by-and-by the state of the case will be altered. But the by-and-by may be a long way off, and the words may only be intended to guard against a remote and unlikely contingency. "At present" we see no signs of a flying machine carrying the mails across the Atlantic; but we need not commit ourselves by saying there is absolutely no prospect of such a thing being accomplished. If, by making use of waterfalls, the advocates of the electric light manage to get their motive power for nothing, they will save coal, and, so far, gain an advantage over gas. At present, we do not see how to make gas profitably out of water, whether it comes in a cascade or in a flowing stream. But the waterfall question involves the further consideration as to the distance to which the electric current can be conveyed. On this point some very interesting experiments have been performed with the Gramme machines and Jablochkoff lights on the Victoria Embankment. It has been found practicable to sustain the lights at a distance of two miles from the generating machine, and there is no indication that this is a final limit. Further experiments are pending, for the purpose of trying a longer distance. The conducting cable has remained unaltered in size, notwithstanding the extension of the circuit. From these results it is naturally argued that the lighting of streets and railway stations from an electric centre is a possible event.

Street lighting, we may observe, offers a tolerably wide field for the electric light, if the latter is able to occupy it. Not only is there a considerable distance to be traversed, but there are an immense number of lights to deal with. At the close of last year the Chartered Company had 35,387 public lamps in their district; the Phœnix, 6064; the London, 5227; the Commercial, 4756; and the South Metropolitan, 4207. These make a total of 55,641. The Surrey Consumers Company had 2087 public lamps in 1877, so that we may now reckon that the total for all London is about 58,000. Mr. Keates has calculated that the twenty electric lights on the Embankment could take the place of eighty-six gas lamps. At this rate, 13,500 electric lamps would be required for all London, and probably more, taking into account the courts and alleys, which have to be lit, where a powerful light would be partly wasted. In computing the horse power requisite to maintain such an illumination, it is only fair to observe that the gross horse power should be taken, and not merely the net. At all events, we may reckon that a total of 13,000-horse power would be requisite to maintain these lights. There is nothing impossible in street lighting by electricity; but of itself it does not seem to offer a promising investment, at least where gas is cheap, as in London. Railway stations may take advantage of the electric light, but many practical points have to be got over before any decided advance will be made. Experiments will abound, lights will come and go, and much time will inevitably be expended ere gas can suffer any material displacement. While this process is going on, other changes will be taking place, including, in all probability, an enlarged demand for gas in various directions. If the Gas Companies are wise, they will be active and enterprising, without being alarmed. The idea that they are to act as the providers of light, whether in the form of gas or electricity, must be held with moderation. There is no need to dispute the opinion of the Select Committee, that "Gas Companies have no *special* "claims to be considered as the future distributors of the "electric light." But, on the other hand, the Gas Companies ought not to be absolutely shut out from such a function, though separate powers might be requisite, so as to keep the two undertakings distinct. The argument that if the electric light were committed to the Gas Companies, they would possibly give it "a slow development" is plausible, and appeals to the popular prejudice, but much would depend upon the terms of the concession. If these were fairly arranged, the Gas Companies would find it to their interest to make the very best of the electric light, presuming the new illuminant to be capable of commercial development.

A little prophesying is evidently requisite with regard to the electric light. The Committee say that "many practical wit-"nesses" see serious difficulties in the speedy adaptation of the electric light to useful purposes of illumination; but, on the other hand, the "scientific witnesses" believe that "in the "future" the electric light is "destined to take a leading part "in public and private illumination." There is an idea that the electric current might be used to transmit power for mechanical purposes during the day, and to afford light during the night. How matters are to be arranged during the dark days we are not told. The choice might sometimes lie between working in the dark, or kindling a light and doing nothing. That the electric current will render important service in the transmission of power is extremely likely, and perhaps more rapid progress will be made in this direction than in regard to the application of the light. Some striking results in the transmission of the electric power have been obtained in France, and when attention is more earnestly directed to this part of the subject, the electric light will probably lose some of its assumed importance.

A TREATISE ON THE SCIENCE AND PRACTICE OF THE MANUFACTURE AND DISTRIBUTION OF COAL GAS.

CLXXXII.

THE TREATMENT OF RESIDUAL PRODUCTS.

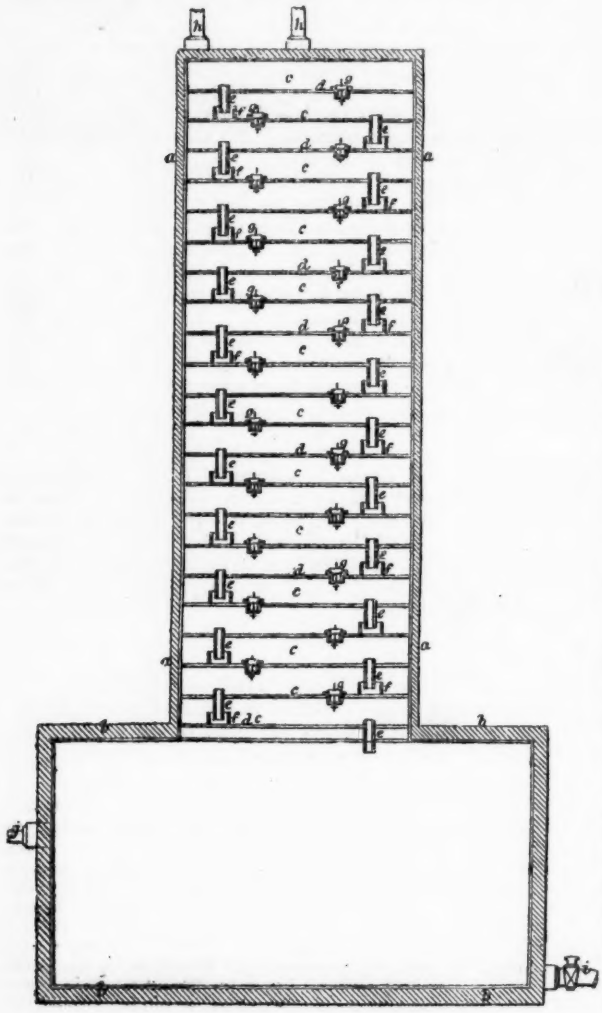
The Manufacture of Ammonia Salts from Gas Liquor.

In working such an apparatus as that figured on pp. 882-3 of the present volume, the boiler is half filled with liquor, and the saturator is charged with equal quantities of acid and water, or acid and liquor, to the height of about 20 inches. The steam is then turned on to the boiler, and the boiling proceeded with until the contents of the saturator are only very faintly acid, when the boiling is stopped, and the solution of sulphate of ammonia is run off into the evaporating pans for concentration. It is best to use in the saturator an amount of acid somewhat insufficient for the complete saturation of the ammonia evolved from the liquor in the boiler; the process of saturation may then be watched by periodical testing with blue litmus paper, and, as the point of neutralization approaches, a little fresh acid may be run in to meet the ammonia still coming from the boiler. By this mode of operation the boiling may be completed, and the contents of the saturator brought to a state of comparative neutrality; but a distinctly acid condition should always be maintained, or a loss of ammonia will accrue.

The proper proportion of acid with which to charge the saturator is obviously dependent on the amount of ammonia evolved from the boiler, and this again depends on the two details of quantity and strength of liquor. As a guide to manufacture, it may, however, be

mentioned that for every one per cent. of available ammonia present in the original liquor in every 100 gallons, 38 lbs. of brown sulphuric acid (sp. gr. 1·7) should be used, or a bulk of (nearly) 2¼ gallons. The theoretical yield of sulphate of ammonia on these quantities would be 38·8 lbs.

At the works of the Newcastle and Gateshead Gas Company, sulphate of ammonia is manufactured in a slightly different way from that which has been described, and the method employed merits a short notice. Two liquor boilers or stills are employed, and are used in series. The first of these boilers is called the weak liquor still. It is provided with a steam worm, and charged with liquor from which the ammonia in the free state, and in the form of volatile compounds, has been expelled. The liquor is treated with a little lime, in order to liberate the fixed ammonia before being admitted to the still. This weak liquor still communicates with the No. 2 boiler, or strong liquor still, by means of a pipe terminating in four arms branching off at right angles to each other, and perforated with holes. (This still is charged with ordinary ammoniacal liquor.) The saturators are charged with sulphuric acid, diluted with water to such an extent as to have a specific gravity of 50° Twaddel. This is found to be the best working strength. The outlets of the saturator communicate with vessels called catch-boxes, which are also charged with sulphuric acid. The apparatus is worked as follows:—Steam is admitted to the No. 1, or weak liquor still, and the ammoniacal vapours and steam pass to the No. 2, or strong liquor still, from the contents of which the volatile ammonia compounds are rapidly expelled and pass to the saturator, any ammonia escaping absorption being arrested by the catch-boxes. The solution of sulphate of ammonia is evaporated in open vessels, and the salts shovelled out, drained, and stored in the ordinary way. At the end of the distillation, the liquor from No. 1 still which is entirely spent is run off, and replaced by the liquor from No. 2, a little fresh lime being added. No. 2 is then charged with fresh liquor, and the manufacture proceeded with in the manner already described.



The so-called continuous method of manufacturing sulphate of ammonia is by far the most complete and efficient system at present in use. The crude liquor, instead of being subjected to heat in a boiler, is distilled by the use of some form of the Coffey Still. The simplest description of this vessel has been already figured in the "Treatise," in the chapter on "Scrubbers." It consists of a rectangular vessel of considerable height, provided with a series of shallow trays, which, in the more complete form of apparatus, are provided with conical valves opening upwards. A diagram of this form of the Coffey Still is given above. It consists of the upright vessel *a, a, a, a*, made of wood and lined with lead, placed on the top of a close cistern, *b, b, b, b*, and subdivided into small chambers, *c, c, c, c, c, c*, by the horizontal partitions or diaphragms, *d, d, d, d, d, d*. These diaphragms are perforated with small holes, and furnished with the short pipes, *e, e, e, e, e, e*, the lower ends of which are inserted into cups or traps, *f, f, f, f, f, f*. The diaphragms are also furnished with valves, *g, g, g, g, g, g*. The ammoniacal liquor is admitted into the apparatus by the pipe, *h*, in the centre of the vessel, and descending from one chamber to another, eventually falls into the close cistern, *b*, from whence it is drawn off by the cock, *i*. Steam is conveyed into the apparatus by the pipe, *j*, and escapes through the exit-pipe, *k*, on the left side of the vessel, *a*. The liquor to be treated is pumped into a tank, the bottom of which is above the level of the top of the still-column. From this tank the liquor flows in a small stream to the top of the still, and then gradually descends by the series of trays. Steam, at about 30 lbs. pressure, is admitted to the bottom of the still-columns, and meets with the descending liquor, from which it liberates the ammonia existing in the free state, and in the form of volatile salts, such as carbonate and sulphide. The flow of liquor is so proportioned to the size of the apparatus and to the efficiency of the steam, that the liquid which runs from the bottom of the still is practically free from ammonia. The ammoniacal vapours evolved by the action of the steam on the liquor pass to one of the forms of saturator already described, while the carbonic acid, sulphuretted hydrogen, and uncondensed steam pass on, and are disposed of in the usual manner. In the event of the closed form of saturator, charged with a comparatively dilute acid, being used, it is advisable to employ two saturators, so that on the contents of one becoming saturated, the ammoniacal vapours can be turned on to the other, and thus the continuity of the manufacture maintained.

The liquid which flows from the still-columns, although containing little or no free ammonia, possesses a small amount of the alkali in the form of fixed salts, chiefly sulphocyanide and hyposulphite. This ammonia may be obtained from the liquor by allowing it to flow in its heated condition into closed receptacles, where it is agitated by mechanical means with a suitable proportion of slaked lime. Ammoniacal gas is given off, which may be conducted to the saturator; and, if necessary, the evolution of the gas may be facilitated by the introduction of steam into the liquid.

The great economy which exists in the manufacture of sulphate of ammonia by the use of modified forms of the Coffey Still is due to the process being continuous, and to the fact that the whole of the ammonia is obtained from the liquor by the expenditure of a minimum amount of fuel. In the treatment of liquor by the old method of direct neutralization by sulphuric acid, and subsequent evaporation, the whole of the water present had to be boiled off in order to obtain the salt, necessitating a comparatively large expenditure of fuel. By the use of the Coffey Still system, the ammonia is liberated from the liquor by a much less expenditure of fuel, the greater bulk of the water present not undergoing evaporation, but simply flowing away from the still, and the amount of fuel which would otherwise have been consumed in evaporating this bulk of liquid is practically saved. Even the heat of this waste liquid is, to a certain extent, utilized in the most complete modes of working, being used to heat the crude liquor previous to its entrance to the still-columns.

The points to which special attention should be directed in sulphate of ammonia manufacture may be epitomized as follows:—

The original liquor should be of good strength, as it is obvious that the larger the percentage of ammonia present, the less the bulk of liquid which will have to be heated in order to procure a given yield of sulphate. On the other hand, the liquor should not be too strong, as, in that case, the evolution of ammonia may be too rapid to be entirely absorbed in the saturator.

The rate at which the ammoniacal liquor should flow into the still-columns should be such that an even evolution of gases is obtained, while the liquid flowing away should not contain more than a mere trace of ammonia.

The pipes and connections conveying away the waste gases from the saturator should be perfectly sound, leakage obviously allowing escape of sulphuretted hydrogen, which would occasion nuisance.

The gases from the saturator should be thoroughly dried, as far as can be accomplished, before being allowed to enter the furnace. This drying is best effected by suitable cooling, which precipitates all excess of aqueous vapour. The comparatively dry gases should be admitted to the furnace at a point where the draught will carry them through and over the mass of incandescent fuel, by which entire combustion of the sulphuretted hydrogen and hydrocarbon vapours is effected, and the ordinary and comparatively harmless combustion-products alone escape into the air. The sulphuretted hydrogen may also be disposed of by means of oxide of iron, used in an ordinary purifier. In this case the sulphur, instead of being wasted, may be recovered by suitable methods.

(To be continued.)

Sales of Gas Shares at Exeter and Eastbourne.—On the 12th inst., 1000 £10 ordinary shares in the Exeter Gas Company, being a portion of the new capital authorized to be raised by the Exeter Gas Act, 1878, and carrying a dividend of 7 per cent. per annum, were sold by auction. The reserve price was £11 per share, or 10 per cent. advance on the nominal value. The first lot, consisting of ten shares, was purchased for £122 10s. The next two lots were each sold for £120, and the fourth lot for £116, the whole of the remainder realized from £11 to £11 12s. per share.—On Wednesday last a number of shares in the Eastbourne Gas Company were disposed of by auction, and realized the following prices:—A shares—ten, £16 per share; three, £16 2s. 6d. per share; ten, £15 15s. per share; five, £15 12s. 6d. per share; five, £15 10s. per share; three, £15 12s. 6d. per share; five, £15 12s. 6d. per share; and two, £15 17s. 6d. per share. Some B shares in the same Company were disposed of at £12 17s. 6d. per share.

Communicated Article.

EXPERIMENTS WITH GENERATOR FURNACES.

V.

By "Isca."

The different experiments whose general results were summarized in the last article are worthy of careful study, and this was felt to be the case by Dr. Bünte, the reporter, who has given full details, as in the previous series, of every circumstance which was noted at the time, in order that as much as possible might be learnt by any one, not actually present, respecting the manner in which the experiments were conducted. Without transcribing every one of these particulars, some few of them may be found interesting, and are as follows:—

Experiment A.—This experiment began with a draught of 0·17 inch in the gas-flue, the generator was stoked up every two hours with quantities of from 150 kilos. to 200 kilos. of coke, and 1875 kilos. were thus gasified in 25 hours. Deducting from this the average amount of residue, or 17·3 per cent., we have the rate of 1490 kilos. of gasified carbon in 24 hours. The quantities of CO_2 and CO in several samples taken from the flue were as follows:—

CO_2 . . .	4·4	5·0	4·5	5·5	4·4—aver. 4·6 per cent.
CO . . .	25·5	27·0	25·0	..	27·5—aver. 26·3 „

During these experiments pipes were fitted to several of the sight-holes in different parts of the generator, and these pipes were connected with pressure-gauges, in order to find the draught at various points of the furnace and of the flue. All these gauges were read hourly, and the result of the observations was to show that there was an average excess in the flue, as compared with the bottom of the generator furnace, of 0·039 to 0·059 inch; but the difference between the top and bottom of the furnace itself—that is to say, the pressure caused by the large English coke which was being gasified—was very small, being hardly half a millimètre (0·019 inch). Unfortunately, these observations could not be carried out during any great length of time, because the gauge-pipes very quickly melted in the interior of the furnace.

Experiment B.—The furnace was now given a draught of 0·27 inch, which subsequently slackened to about 0·25 inch. The draught was found to change by about 0·12 inch between the intervals of clinkering, so that the gauge ranged between 0·31 and 0·17 inch, in accordance with the amount of obstruction from the presence of clinker. The gauge was read every 50 minutes. During the experiment 2320 kilos. of coke were consumed. Deducting refuse, this makes 1919 kilos. of carbon gasified. The composition of the gas was as follows:—

CO_2	8·0	..	5·5	..	7·5—aver. 7·0 per cent.
CO	21·0	..	24·0	..	20·5—aver. 21·8 „

Experiment C.—At the commencement of the third experiment the damper was closed until pressure was observed in the flue, and this was kept up for 20 hours, during which time 616 kilos. of coke were consumed, which equals, deducting residue, 611 kilos. of carbon per 24 hours. The composition of the gas at every trial was very uniform, being as follows:—

CO_2	2·0	..	2·2	..	2·2—aver. 2·1 per cent.
CO	30·0	..	27·8	..	27·8—aver. 28·5 „

The gas continuously escaped from every sight-hole, as might have been expected.

Experiment D.—The damper was now entirely opened until the full draught of 0·345 inch was obtained; the furnace was worked 11 hours, and was charged only thrice during that period, and 1375 kilos. of coke were consumed, or at the rate of 2481 kilos. of carbon per 24 hours. The particulars respecting the height of fuel, as considered with regard to the composition of the gas, have already been given in full. The constitution of the gas was very uniform.

Experiment E.—This has also been described. During the 20 hours which this experiment lasted, there was a pretty constant pressure before the damper of 0·08 inch, a pressure arrived at by none of the previously tested varieties of coke. This must be ascribed to its large size.

Experiment F.—The consumption of coke having greatly decreased towards the end of the last experiment, the draught was made 0·08 inch, which rose slightly during the 23 hours during which the experiment lasted. 1260 kilos. of coke were consumed, 150 to 160 kilos. being put in at intervals of three hours; thus making 1088 kilos. of carbon gasified per 24 hours. The gas contained 2·4 per cent. of CO_2 and 29·2 per cent. of CO. At the end of this experiment the working was interrupted by the breaking of the damper, which rendered it impossible to control the draught. However, by putting stones in the flue the channel was contracted until the pressure-gauge stood at 0, thus showing neither pressure nor draught in the flue.

Experiment G.—This experiment does not call for much remark, it possessing no especial peculiarities save those noted in the tables.

Experiment H.—During this last experiment, which was carried out during a full day of 24 hours, the gauge was not read every hour, but before and after clinkering, which took place every 45 minutes; and by this means the average maximum and minimum of draught during the experiment was observed. The observations showed an average of 0·12 inch before clinkering, and of 0·042 after that operation, while the slit was quite clean, which is a difference of about 0·78 inch. As the programme did not permit of a greater difference than this, the clinkering was necessarily very frequent; but if the mean of these pressure readings were taken, a result would be obtained not strictly commensurate with the other experiments, for it was found that the minimum draught, such as is established immediately after cleaning, does not last very long, but a normal rate, closely approaching the maximum, is soon arrived at. Therefore an equilibrium draught-average was settled, and recorded in the tables for this experiment. The analysis of the gas was as follows:—

CO_2 .	2·6	2·6	3·2	3·8	3·4	3·6—aver. 3·1 per ct.
CO . .	25·0	26·0	25·8	25·2	25·6	24·4—aver. 25·5 „

At the end of the experiment the damper was closed, so that pressure was again established in the flue. The before-described phenomena again occurred, the fire grew feeble, and the percentage of CO_2 gradually increased.

The series of experiments with the slit-generator was now brought a close.

II.—*Experiments with Grate-Generator and Steam Inlet.*

As already stated, the experiments with English coke and steam in a grate-generator were made directly after the experiments with Zwickau coke previously recorded. The most important results of these seven experiments are recorded in a tabular form to follow. It is quite clear that the ashes over the grate or fire-bars have considerable influence on the working capacity of the generator. When the refuse of a period of from 12 to 24 hours burning accumulates on the bars, as it does, to a height of several decimètres, the intake of air will be obstructed, and the working power of the generator will be diminished after a while, with a regular draught, if the grate gets covered with clinker caused by insufficient supply of steam; or if by the admission of too much steam, dirty, coherent ashes be formed. Yet it is not difficult to so regulate the steam inlet that only porous ashes, mixed with small pieces of clinker, accumulate on the bars, which will not decrease the admission of air in twelve hours working as much as is represented by a difference in draught of from 0·039 to 0·08 inch, or as much as happens in a single hour of working without steam in a slit-generator. Under these circumstances, the generator exerts its best capabilities—*i.e.*, a large quantity of coke is gasified with little draught.

Table IV.—*Statement of the General Results of Working a Grate-Generator with English Coke and Steam.*

No.	Experiment.	Steam Decomp. to every Kilo. C.	Chemical Composition. CO_2. Per Cent.	CO. Per Cent.	H. Per Cent.	N. Per Cent.	Carbonic Gases, $CO_2 + CO$. Per Cent.	Combustible Gases, $CO + H$. Per Cent.	Dead Gases, $CO_2 + N$. Per Cent.	Draught in the Flue. In.	Temperature of the Gas.
I.	K	·38	9·5	17·2	6·8	66·5	26·7	24·0	76·0	−·244	1382
II.	—	·51	10·0	17·5	9·3	63·2	27·5	26·8	73·2	−·094	—
III.	O	·52	9·2	18·9	9·8	62·1	28·1	28·7	71·3	−·177	1472
IV.	—	·63	11·0	15·0	11·0	63·0	26·0	26·0	74·0	—	1202
V.	I	·72	12·1	13·6	12·3	62·0	25·7	25·9	74·1	−·070	1202
VI.	N	·74	10·0	15·0	12·3	62·7	25·0	27·3	72·7	+·003	—
VII.	—	·77	12·0	12·5	12·6	62·9	24·5	25·1	74·9	−·094	—
VIII.	M	·78	12·7	14·8	14·4	58·1	27·5	29·2	70·8	−·094	1418
IX.	L	·91	16·2	8·1	14·9	60·8	24·3	23·0	70·8	−·192	1418

Experiment O gives the best results; experiment K, with too little steam (0·38), and the fire-bars covered with clinker, and experiment, L and M, with too much steam and dirty ashes, are the least successful. The others are about an average.

The gas produced with steam contained more CO_2 than in the case of Zwickau coke. This was owing to the stronger draught employed in the present series, and to the infiltration of air through the furnace walls thereby occasioned, aggravated in the present instance by the somewhat dilapidated condition of the generator before referred to.

The particulars of the experiments are briefly as follows:—

Experiment I.—To enable a comparison to be made between the English coke and Zwickau coke, the positions of the damper and the steam-cock were, for the first experiment, left precisely the same as for the immediately preceding experiment with the latter. The draught increased a little during the experiment, and averaged 0·07 inch. During the 21 hours in which the experiment was carried on, 350 kilos of coke were gasified, and 160 kilos of refuse were removed, thus being equal to 811 kilos of carbon gasified per 24 hours.

The samples of gas contained—

CO_2 . .	11·8	13·0	12·0	11·4	—	12·1	aver. 25·7 per cent. carbon gas.
CO . .	13·8	12·2	13·4	14·2	14·4	13·6	
H. . .	11·6	12·0	13·2	13·3	11·3	12·3	„ 25·9 p. ct. combust. gases

It will be found from this analysis that there was 0·72 kilogramme of steam decomposed in the generator to every kilogramme of carbon gasified, or rather more than in the preceding experiment with Zwickau coke (0·70). The gas contained, with a similar quantity of H, less CO and more CO_2, and its temperature in the flue was 1202° Fahr. The refuse on the bars consisted of brittle clinker, easily removable, so that even with this description of coke, and a quantity of water equal to 70 per cent. of the gasified carbon, the desired effect was obtained.

It was of interest to find the temperature of the generator when gasifying coke with steam. The copper cylinder of a Siemens pyrometer was therefore inserted into the mass of coke through the highest sight-hole in the furnace, and it was found to register 1796° and 1832° at two different trials.

Experiment K.—The position of the steam-cock and the pressure of the boiler remained the same as before, but the damper was opened to give a draught of 0·24 inch, whereby the consumption of coke was increased, and consequently its proportion to the steam intake raised. The alteration immediately caused a decrease in the quantity of H and CO_2 in the gas. The gas of the previous period having

contained, on an average, 12·1 per cent. of CO_2 and 12·3 of H, the gas now contained, at different periods—

CO_2 . .	9·5	9·5	9·5	9·5	9·5	} aver. 26·7 per cent. carbon gases.
CO . .	17·6	16·5	20·7	15·5	15·5	
H . .	6·3	5·0	6·0	7·0	9·5	} „ 24·0 p. ct. combust. gases.

This shows a steam intake of 0·38 parts to 1 of carbon gasified. After about eight hours working there was a brittle covering of clinker over the bars, and fluid slag trickled down among the white-hot coke. The steam was consequently too stinted, and the cock was opened until the H present in the gas rose to 11 per cent.—*i.e.*, until the previous conditions were recovered. In the next twelve hours working nothing formed on the bars but ashes mixed with the remains of the first-formed clinker. The temperature of the gas was 1382° at the end of the experiment. During the 24 hours of this experiment the consumption of coke was 1315 kilos., less refuse, with an average draught of 0·244 inch.

Experiment L.—The draught was lowered to 0·14 inch, and the admission of steam was unchanged. In a short time the quantity of CO_2 and H present in the gas was considerably increased. Samples showed the following compositions:—

CO_2 . .	17·0	15·8	16·0	16·0	16·2	16·2	} aver. 24·3 per cent. carbon gases.
CO . .	6·0	9·2	8·6	8·6	8·1	8·1	
H . .	—	—	15·0	14·7	14·9	14·9	} „ 23·0 p. ct. combust. gases.

This makes 91 per cent. of water to the carbon consumed. The former experiment had proved that with such a large proportion of H, the maximum of steam which could be decomposed must have been admitted. But it was possible that, under the actual circumstances, an excess of steam had really been supplied, of which a portion had escaped decomposition. In fact, a cold glass tube which was used for aspiration was soon made wet.

Thus it appears that the quantity of steam, as calculated from the analysis, only represents that portion of the total admitted which was really *decomposed*, the remainder being unknown. (This contingency has been foreseen by the present writer in the course of his remarks on the previous series of experiments.) The total quantity of steam passed into the generator may be checked by an examination of the gas drawn from the midst of the fuel, by means of a clean iron tube. An iron pipe was therefore pushed into the glowing coke, and soon becoming bright red, at this temperature it decomposed the remaining steam, and separated the H, which the coke itself had not been able to effect. Gas taken in this way contained, as ascertained by two samples—

CO_2	13·8 . .	14·3—aver. 14·0 per cent.	
CO	14·0 . .	15·7—aver. 14·9	„
H	24·6 . .	24·0—aver. 24·3	„

From the close approximation of the two analyses, it would appear that the whole of the steam had been decomposed in passing through about 3 ft. 3 in. of pipe. On this assumption, the consumption of carbon to water would be as 1 to 1·27. That the complete decomposition of the steam was effected in the iron pipe, and not in the coke of the generator, was further proved by taking a sample from the midst of the furnace by means of a glass pipe protected by a casing of iron. This sample contained

CO_2, 16·0; CO, 8·6; H, 15·0 per cent.

—the same, in fact, as the samples drawn from the flue.

As only 0·91 kilo. of steam was decomposed from 1·27 kilos. introduced per kilo. of carbon, it follows that nearly 25 per cent. of the whole passed completely through the furnace without being further affected. This being the case, the coke inside must have reached the minimum temperature, with which a further decomposition of water could not take place. The temperature of the fuel at the height of 5 feet above the grate was twice measured with a pyrometer, and was found to be 1508° and 1688° Fahr. The temperature of the gas in the flue had decreased by 212° during six hours working, and was then only 1238°. The quantity of coke consumed during the twelve hours experiment with a draught of 0·19 in. was, less the residue, 891 kilos.; that is to say, a small effect both as regards quantity and performance. There was nothing but ashes on the grate.

Experiment M.—This experiment was made with less draught and less steam. The pressure of steam having increased during the experiment, the quantity of CO_2 as well as of H also increased. The first sample is an average of four hours from the beginning, the two latter show the quality of the gas towards the end of the experiment:—

CO_2 . . .	9·5	14·5	14·0	12·7	} aver. 27·5 per cent. carbon gases.
CO . . .	16·1	13·0	15·4	14·8	
H . . .	12·0	15·9	15·3	14·4	} „ 29·2 p. ct. combust. gases.

There was thus an average decomposition of 0·78 kilo. of steam per kilo. of coke. The quality of the refuse on the bars was good, chiefly ashes, with but little clinker. In 24 hours 688 kilos. of carbon were used, with an average draught of 0·09 inch. In finishing the experiment, the quantity of steam having been still further reduced, gases of the following compositions were obtained:—

CO_2, 12·0; CO, 12·5; H, 12·6 per cent.
CO_2, 10·0; CO, 17·5; H, 9·3 „

In the former case, 0·77 kilo. of steam, and in the latter 0·51 kilo. were decomposed per kilo. of carbon.

Experiment N.—This experiment was made with the damper almost closed, and with a moderate supply of steam. For 14 hours there was an average *pressure* of 0·003 inch in the flue. An average of the analyses for five hours show a composition—

CO_2, 10·0; CO, 15·0; H, 12·3 per cent.,

which indicates 0·74 kilo. of steam to 1 kilo. of carbon. In 24 hours 429 kilos. of carbon, less refuse, were consumed. The refuse was good, consisting of ashes mixed with a little clinker.

Experiment O.—During this experiment of 14 hours, 950 kilos. of coke were gasified, or 1460 kilos. per 24 hours, deducting ashes. The gas was tested several times, and contained—

CO_2 . .	8·0	9·0	9·5	10·2	9·2	} aver. 28·1 per cent. carbon gases.
CO . .	18·0	21·4	17·7	18·6	18·9	
H . .	10·6	7·3	9·7	11·5	9·8	} „ 28·7 p. ct. combust. gases.

This indicates 0·52 kilo. of steam per kilo. of coke. As already mentioned, there was porous brittle clinker lying on the bars after finishing the experiment, which caused very little obstruction to the entrance of air. By this fact the working effect of the generator was increased in proportion to the draught, yet it is doubtful if this condition could be long maintained, as coherent though brittle clinker stuck to the sides of the furnace, even during the brief period of the experiment.

Experiment P.—The last experiment was made with the damper quite open, and an average draught of 0·4 inch in the flue. The supply of steam was regulated to give 14 per cent. of H in the gas—*i. e.*, the exact quantity necessary to prevent clinker was admitted. A sample showed—

CO_2, 10; CO, 19·2; H, 14 per cent.

There was thus 29·2 per cent. of carbon gases, and 33·2 per cent. of combustible gases, and to every kilo. of carbon, 0·72 kilo. of water was decomposed. During the six hours working, 625 kilos. of coke were put in, and nothing was removed; this equals 2088 kilos. of coke, deducting ashes, per 24 hours.

Finally, in the table will be found a ready means of comparing the various experiments, and the general results of the previous investigations will be seen to be confirmed thereby. Broadly speaking, the advantage is still on the side of the grate-generator worked with steam, as compared with the slit-generator without it.

Correspondence.

[*We do not hold ourselves responsible for the opinions expressed by Correspondents.*]

THE PROPOSED WIDENING OF THE SCOPE OF THE BRITISH ASSOCIATION OF GAS MANAGERS.

Sir,—In the report of the meeting of the British Association of Gas Managers at Newcastle, I notice that the President, in referring, in his Inaugural Address, to the gas manager of the future, expresses a desire to see the basis of the Association enlarged by the formation of a lower grade of members, to be called associates, from whose ranks the members would be chosen, after having given satisfactory proof of their qualification therefor.

Now, Sir, you very justly remark that, in the management of gas-works, much depends upon intelligent and well-conducted foremen, and these, you think, should be eligible for admission to the Association. I know that there are a number of such men, who take as much interest in the work of gas-making as the managers themselves, and who, I am sure, would consider it an honour to be connected with such a society as the British Association of Gas Managers, and that a great boon would be conferred upon them by their admission to its deliberations. The good that would result from such an arrangement would be twofold—the men would be stimulated to do their utmost to prepare themselves to attain the honourable position of members of the Association, and, at the same time, the managers would feel that those they had about them really had their interests at heart.

I know there are many men who would regard admission to the meetings of the Association as the opening to them of a way of increasing their store of knowledge, without the least thought of soaring so high as to be future managers; and, therefore, I hope that at the next meeting of the Association the members will see their way to put Mr. Warner's suggestion into some practicable form.

June 19, 1879. Ambition.

THE ANALYSIS OF GAS COALS.

Sir,—Should this question be allowed to remain in the position in which Mr. Paterson's communication in your Journal of the 17th inst. places it, practical gas managers will not obtain any relief from the numerous annoyances and heartburnings that frequently arise from discrepancies between the quantity of gas they sell during a year, and the results fairly estimated from the chemical certificates of the quantity of gas and other products which certain coal contains. "Absolute commercial value," by which Mr. Paterson evidently means the sum of all products of coal distillation, is a vague, misleading phrase; for, in the first place, the amount and variety of products must depend upon the perfection of the apparatus employed, whether in laboratory or gas-works; and, secondly, the value of each must depend on the demand for it in the market.

It is quite right that practical gas managers should be stimulated to invent apparatus and adopt methods which may give as good results as those arrived at by a philosophic chemist in his laboratory, and nothing that has been stated during this little controversy militates against this; but that does not much affect the question raised by Mr. Scott—viz., whether, considering the whole subject, the time has not come for testing coal in bulk in ordinary gas-making apparatus, so that purchasers may know what can actually be taken from a hundred or a thousand tons by estimate from what has been taken out of five or ten. This is the broad aspect of Mr. Scott's question, and gas managers are less intelligent than I think they are if they allow the question to subside in the misty waters of chemico-philosophical disquisitions.

Whether such testing works as Mr. Scott's paper suggests should be in the hands of Gas Managers Associations, or of private parties prepared to go into the work on purely commercial grounds, is a fair question for consideration. It might be assumed that Associations would have less inducement than private parties to be drawn into collusion

with coalowners; but, on the other hand, a long time would be taken up in discussions before an Association found itself prepared so to test coal, and the much-needed improvement might be indefinitely delayed. If good registering apparatus were attached to such works, all collusion would be nearly impossible if gas managers were free to look in when they chose. I, therefore, hope that either some of our Associations or other private parties will come forward to produce estimates of coal value on which practical men may be able to rely without deduction of 10 to 25 per cent. from the laboratory tests, which, at present, are the only extant indices to the commercial value of coal.

R. Miller.

Innerleithen Gas-Works, June 19, 1879.

PARIS STREET LIGHTING.

Sir,—With reference to the system of lighting one of the streets in Paris, described in the Journal of last week, will you permit me to say, while congratulating the Paris Gas Company on their success, that the system you describe was patented by me several months since. I do not mean to charge them with plagiarism, as they could not possibly have seen my specification, or known anything of my invention before showing their apparatus. It is simply another instance of minds working separately and tending to a common goal. In this case I have arrived at the Patent Office a good long time in advance of my contemporaries. The plan described is not the simplest or most efficient of my combinations, and is not the one I have adopted for outside purposes.

Geo. Bray.

Leeds, June 21, 1879.

LIGHTING BY ELECTRICITY.

Sir,—The evidence and report in this matter being now complete, it will shortly be published in an official shape, with the witnesses corrections, as a Blue-Book, at a price, including postage or delivery, of about 3s. or 3s. 2d.

As the House of Commons printer, beyond supplying a copy to each member, does not strike off any large number for the public, and there are likely to be an unusual number required in this case, if any of your readers wish for a copy, and will let me know, I will arrange that it is sent to him in due course. As this question is sure to crop up again and again, every gas company should have a copy of these proceedings, as a record of what has been done hitherto.

Wm. Livesey.

Gas and Water Companies Association, 6, Victoria Street, Westminster Abbey, S.W., June 21, 1879.

THE HIRE OF GAS-COOKING APPARATUS.

Sir,—Can you, or any of the numerous readers of your Journal, inform me of any gas companies, whose consumers do not number more than 350, who have tried the experiment of introducing a system of hire or sale of gas-cooking apparatus? The Directors of the Company of which I am the Secretary are considering the expediency of adopting a system of letting out such apparatus, and I should be extremely glad to obtain any practical hints on the subject, or any statistics as to the success or otherwise of such an experiment.

An Old Subscriber.

June 19, 1879.

Civis writes: "Perhaps some of your readers, who have had experience in the matter, will kindly inform me, whether there is any real and serious objection to leaving retorts or fire-clay goods exposed to rain, snow, and cold, or whether the action of all these, together with the summer heat, would be detrimental to these goods. I have repeatedly seen retorts and fire-bricks kept in the open air (not under roof) in English gas-works, and have been told by the respective managers that in an English climate there is no objection to doing so; but I should like to know whether this could be done equally in a Continental climate, which is very hot in summer and extremely cold in winter?"

Explosion at the Ramsgate Gas-Works.—On the evening of Tuesday, the 10th inst., shortly after ten o'clock, the whole of the gaslights in the district of the Ramsgate Local Board gas supply were suddenly extinguished. The Gas Committee of the Local Board have since issued the following report on the subject:—"The internal mains have lately been undergoing some alterations, in consequence of which a considerable length was cut off, or what is technically called 'laid dead.' By some means, not at present quite clear, the contents (a mixture of gas and air) of this piece of main fired. The cause is supposed to have been some of the workmen endeavouring to light a lamp in connection with the main, the force of the explosion removing the face of a valve in connection with one of the gasholders. To prevent any possible mishap, the gas was immediately shut off from the town, and, although a full supply could have been maintained throughout, the Chairman of the Gas Committee, after a consultation with the Engineer, decided that it would be more prudent to discontinue the supply till the next morning. Mr. Valon, the Engineer, Mr. Hubbard, the Clerk, and several members of the Local Board, and the Rev. E. G. Banks, the Chairman of the Gas Committee, were promptly on the spot."

Ipswich (Queensland) Gas Company.—The second annual meeting of this Company was held on the 10th of March last—Mr. T. B. Cribb in the chair—when the Directors report for the year ending Feb. 28, which was presented, stated that, "As foreshadowed in our last report, the plant and works have been erected, and the major portion of mains laid down, under the personal supervision of Mr. Henry Courtis, of Melbourne, who has carried out his undertaking to the entire satisfaction of the Directors, and with great economy to the Company. The Directors have engaged Mr. W. Hooker as General Manager, and, so far, have every reason to be satisfied with his management. The town was lighted with gas for the first time on the night of the 14th of August last, thus showing a clear six months working; and the Directors note with pleasure a steady increase in the number of consumers from month to month. It is most gratifying to report also that excellent results have been obtained from the local coal, which yields a large percentage of gas of a first-class quality, rendering the consumption of any coal or shale from other colonies unnecessary. The profit and loss account shows a net profit of £461 7s. 9d., which the Directors propose to appropriate as follows:—viz., £181 7s. 9d. towards reduction of preliminary expenses, and £280 in paying a dividend at the rate of 4 per cent."

Parliamentary Intelligence.

HOUSE OF LORDS.

Monday, June 16.

Imperial Continental Gas Association Bill, Ilkley Gas Bill,—reported, without amendment.

The Examiners reported that the further Standing Orders applicable to the Derby Improvement Bill have been complied with.

The Examiners reported that no further Standing Orders are applicable to the following Bills:—Alliance and Dublin Consumers Gas, Blackpool Extension and Improvement, Leicester Corporation, Newcastle-upon-Tyne and Gateshead Gas, South Shields Gas.

The Examiners reported that the further Standing Orders applicable to the following Bills have not been complied with:—Knutsford Light and Water, Lancaster Gas, Queenstown Gas. The certificates of non-compliance were referred to the Standing Orders Committee.

Bills read a second time, and committed:—Blackburn Improvement, Cardiff Corporation, Gas and Water Provisional Orders Confirmation (Thirsk District Water Order), Morecambe Gas, Nottingham Corporation, Over Darwen Corporation, Plymouth and Stonehouse Gas, Preston Gas, Stourbridge Gas, Stratford-upon-Avon Corporation and Local Board of Health, Weardale and Shildon District Water, Wisbech Gas, Wombwell Local Board.

Nelson Local Board Bill,—read the third time, with the amendment, and passed.

The Crystal Palace District Gas and the Mirfield Gas Bills were referred to a Select Committee, consisting of Lord Blachford (Chairman), Earl Rosse, Lord Lyveden, Lord Annaly, and Lord Grey de Radcliffe; to meet on Thursday, June 19.

Tuesday, June 17.

The Standing Orders Committee reported that the Standing Orders not complied with in respect of the following Bills ought to be dispensed with:—Colchester Water, Knutsford Light and Water, Lancaster Gas, and Queenstown Gas.

Colwyn Bay Water Bill (Lords),—returned from the Commons, agreed to, with amendments.

Bills read a second time:—Alliance and Dublin Consumers Gas, Blackpool Extension and Improvement, Derby Improvement, Knutsford Light and Water, Lancaster Gas, Leicester Corporation, Newcastle-upon-Tyne and Gateshead Gas, Queenstown Gas, South Shields Gas.

Colchester Water Bill,—read a second time, and committed.

Thursday, June 19.

Colwyn Bay Water Bill,—Commons amendments agreed to.

Over Darwen Corporation Bill, Stourbridge Gas Bill,—reported, with amendments.

Aire and Calder Navigation Bill, Warrington Corporation Bill,—reported, without amendment.

Ilkley Gas Bill, Imperial Continental Gas Association Bill,—read the third time, and passed.

Friday, June 20.

Bills committed:—Alliance and Dublin Consumers Gas, Blackpool Extension and Improvement, Derby Improvement, Knutsford Light and Water, Leicester Corporation, Lancaster Gas, Newcastle-upon-Tyne and Gateshead Gas, Queenstown Gas, South Shields Gas.

Blackburn Improvement Bill,—specially reported, with amendments.

The Gas and Water Provisional Orders Confirmation Bill (Thirsk District Water Order) was referred to a Select Committee, consisting of Earl Powis (Chairman), Earl St. Germans, Lord Stewart of Garlies, Lord Inchiquin, and Lord Elgin; to meet on Tuesday, June 24.

The Cardiff Corporation Bill was referred to a Select Committee, consisting of Lord Strafford (Chairman), Earl Mar and Kellie, Lord Balfour of Burley, Lord Cloncurry, and Lord Sandhurst; to meet on Tuesday, June 24.

Petitions against the following Bills were presented:—Alliance and Dublin Consumers Gas, from Consumers of gas in the city of Dublin and its vicinity; Blackpool Extension and Improvement, from Owners of property in Claremont Park, Blackpool; Knutsford Light and Water, from Henry Rose (on behalf of himself and the Rev. Edward Penrose Hathaway and John Pennington Legh).

Petitions against alteration in the Birmingham Gas Bill were presented from (1) Owners, &c., of property and consumers of gas in Northfield, (2) Owners, &c., of property and consumers of gas in Yardley.

HOUSE OF COMMONS.

Monday, June 16.

Colwyn Bay Water Bill (Lords),—read the third time, and passed, with amendments.

The Rochester Corporation Bill was reported: "Parties do not proceed."

Wednesday, June 18.

METROPOLITAN BOARD OF WORKS (WATER EXPENSES) BILL.

The Chairman of Ways and Means (Mr. Raikes) gave notice that on the second reading of the Metropolitan Board of Works (Water Expenses) Bill, he will move—"That no measure proposing to exonerate members of a municipal or *quasi*-municipal body from liability for costs which have been disallowed by the proper authority, and to impose such liability on ratepayers, should be considered by this House, unless it is introduced by Her Majesty's Government on their own responsibility."

Friday, June 20.

A petition against the Metropolitan Board of Works (Water Expenses) Bill was presented from the Vestry of St. George's, Hanover Square.

HOUSE OF LORDS COMMITTEE.

Friday, May 9.

(*Before Earl* Morley, *Chairman; Earl* Manvers, *Lord* Clifton, *Lord* Lovel and Holland, *and Lord* Romilly.)

GLOSSOP GAS BILL.

Mr. Richards, Q.C., and Mr. Michael, Q.C., appeared for the promoters; and Mr. Aspinall, Q.C., and Mr. Balfour Browne for the Corporation of Glossop, petitioners against the Bill.

Mr. Richards, in opening the case for the promoters, said that the Glossop Gas Company were originally incorporated by Act of Parliament in 1845, and under that Act the dividend of the Company was limited to a maximum of 7½ per cent., and the price to 6s. per 1000 feet. As a matter of fact, however, the Company had been charging only 5s. 2d., with 5d. discount if paid within a month. The town of Glossop, like many other places, had been growing, and the Gas Company found a difficulty in meeting the increasing demands upon it; they had, therefore, found it necessary to introduce the present Bill, by which they proposed to acquire

additional land for their works; to raise £40,000 additional capital; and to introduce the auction clauses. They proposed to leave the price as it was, but to place themselves under an obligation to supply gas of 15-candle illuminating power. The only petitioners against the Bill were the Corporation of Glossop, who objected to more than £10,000 of fresh capital being raised, though their own skilled witness in the House of Commons had admitted that they ought to have £20,000; and they further asked for the illuminating power to be raised to 18 candles, which was an unreasonable demand.

The following evidence was then called:—

Mr. *S. Robinson*, examined by Mr. MICHAEL.

I have been a Shareholder in the Gas Company since 1848, a Director since 1860, and Chairman since 1866. We have endeavoured constantly, as a Board of Directors, to give satisfaction to the public in the supply of gas; but there are still a very large number of houses not supplied with gas, owing, to some extent, to the bad condition of the fittings. We now, however, have an improved kind of burner, which enables us to supply gas in a much better way. By the incorporation of the General Act of 1871 we place ourselves under strict regulations, which did not previously exist, as to the pressure, and so on. The Directors feel it necessary to obtain additional land at the extremity of the borough of Glossop, upon which to erect new works. Our present works are in the centre of the town, and surrounded by houses, and we have no facilities whatever for increasing them. The whole capital has been raised, with the exception of £1800, and it is necessary that we should have further powers. We have not expended capital, except when it was absolutely called for in the interests of consumers, and we are certainly not likely to do so. The auction clauses will apply to the whole of the new capital.

Cross-examined by Mr. BALFOUR BROWNE: I do not know the number of consumers, but I should say that it is more than half of the whole population. The remainder do not prefer candles, but there is a strong competition in the town with the petroleum oil sellers. By our Bill, as originally drawn, we only proposed to give 14 candles, but the House of Commons made us give another candle. I am not aware that the illuminating power of gas at Ashton is 16 candles, neither am I at all acquainted with Stockport. There was a public meeting held with reference to the gas supply of the borough, either in 1874 or 1875, I will not be sure which. I believe the object of the meeting was ostensibly to establish a rival company, and to find fault with the existing Company. At that meeting fault was found with the supply of gas, but it is not an uncommon thing to find people dissatisfied with a gas company's supply. The present price we are allowed to charge is 6s., but our maximum price is 5s. 2d., subject to a discount of 5d. per 1000, and we propose to continue that maximum price of 6s. We are not very favourably situated for obtaining coal at Glossop. I do not know the number of miles we have to bring our Silkstone, but I may mention that to Ashton and other places quoted, coal is delivered for less money than it is delivered to us. That is owing to competition on the railways, while we are locked in with one railway.

Mr. *James Dalgliesh*, examined by Mr. MICHAEL.

I am Engineer and Manager of the Glossop Gas-Works, having been appointed in 1875. The lands of the Company occupy 7912 square yards, 6987 of that quantity being covered with the manufacturing and distributing plant of the Company, which gives about 26 square yards per 1000 feet of maximum production. Our production in the year ending Dec., 1871, was 38,754,600 feet, the largest production in one day being 242,000, and the minimum 47,000. In 1869, the production was 26,855,000, and in 1878, 38,754,000. If we take the year 1876 to 1877, which was my first year, the increase was 17·15 per cent. Our present charge is 4s. 9d. net, and we go down to a minimum of 3s. 7d. to large consumers. The length of our mains is about 22 miles, and the size varies from 14 inches to 2 inches. The total expenditure on manufacturing and distributing plant to December, 1878, was £32,422 17s. 11d., and that works out to £832 per million feet of gas. The public lamps have been supplied on the average meter system, at the rate of £1 2s. 2d. per lamp, subject to a discount of 5d. per 1000, which really makes it £1 0s. 1·8d. per lamp. The net average price is 4s. 1·8d. per 1000. We have 2126 house and shop consumers, and 27 firms. There are 1064 houses in Glossop with our supply on, but taking no gas. This [producing a fitting] represents the wretched state of the fittings, and I attribute the non-taking of gas, in a large measure, to those fittings, which have been put in for a number of years, and give a miserable supply of gas. In all cases we now object to supply a house unless the consumers will put on an improved main-tap, and that deters many from taking the gas, because they would have to pay the cost of the tap themselves. The burners also are very defective, having been in use many years without being changed, and I know cases where the owners admit they have not been changed from five to six years. I consider it is necessary to enlarge our works, the present ones being incompetent to meet the increased demand, and I recommended the scheduling of the proposed site as the most favourable. In obtaining land for the extension of the works, we thought it desirable to go to the outside of the district, adjoining a new branch railway, which will enable us to manufacture gas better and cheaper than by constructing new works upon our present limited area. We should be able to work with a diminished day pressure, our present pressure being as high as 12-10ths, whereas from the proposed site we could work at from 4-10ths to 6-10ths. The average we pay for coal is 12s. 11·46d. We use a portion of cannel to make our gas, the illuminating power we practically supply being 16 candles. When we are under the obligation to supply 15 candles, we shall be obliged, in order to avoid coming under penalty, to keep 1½ or 2 candles higher than the specified number. Our present contract price for cannel is 19s., and we use one-third cannel to two-thirds coal to make 16-candle gas. The average price of the coal and cannel is 12s. 11·46d. delivered at the works. From that mixture our present working is about 19,000 feet per ton. The unaccounted-for gas last year was exceedingly heavy, owing to the severe winter. We had a series of mains broken, so that the leakage was 21·3 per cent., which is extraordinary. We have not paid our maximum dividend, there being still arrears to the amount of £3403. If we take the price proposed by the Corporation—viz., 3s. 10d.—and take our prices of coal and cannel in 1873, there would be an actual loss on the year's working of £1125 9s. 9d. That was the year of the coal panic. At the present price of coal, and the Corporation rate for gas, it would show a profit of £1825 11s. 9d., which would only pay a dividend of £5 19s. 4d. per cent. on the present capital of £30,600, and would allow nothing for the expenditure of the new capital which is required. If we obtain our Act, we shall be obliged to supply gas at a certain pressure, and we shall also be under the General Acts with reference to public and private lighting.

Cross-examined by Mr. ASPINALL: I did not tell the Committee of the House of Commons that one reason why so many of the inhabitants did not use the gas was because of some extraordinary taste the people of Glossop had for cultivating cottage plants; and, if any of the other witnesses said so, it was no theory of mine. The Company have no control over the gas-fittings in the houses, but merely up to the meter. The fittings which have been shown were taken from houses the occupiers of which have applied for gas, and of course we objected, unless they would take the improved tap, which they consented to do. I do not think there is in England a worse-fitted town than Glossop, the work having been practically done by tin-men prior to 1874. Last year, with the view of protecting the public, and taking away the complaints from the Company, I drew up a copy of regulations for gas-fitters, which I am glad to say they adopted. They were as follows:—

GLOSSOP GAS COMPANY.

Regulations to be observed by the Authorized Gas-Fitters:

1. Previous to any service-pipe being laid to premises intended to be lighted with gas, a written application, signed by the authorized fitter or owner of property, stating name and address of the person for whom a service-pipe is required, addressed to Manager of the gas-works, is to be delivered at the office of the Company.

2. In any case, before commencing the work, it is important that the fitter should arrange with the Gas Manager as to the best position for the meter, which will require to be fixed in the most suitable place for the supply-pipe, and where it can be easily seen by the meter inspector, in as low and cool a situation as the premises to be lighted will admit of, and should not on any account be exposed to the action of the weather, especially frost or excessive heat.

3. The meters are supplied and fixed by the Gas Company only, and can be hired at the following rates:—

	s.	d.	
2-light meter, to supply 4 lights . .	0	9	per quarter.
3 ,, ,, 6 ,, . .	1	0	,,
5 ,, ,, 10 ,, . .	1	2	,,
10 ,, ,, 20 ,, . .	1	6	,,
15 ,, ,, 30 ,, . .	1	9	,,
20 ,, ,, 40 ,, . .	2	0	,,
30 ,, ,, 60 ,, . .	3	0	,,
50 ,, ,, 100 ,, . .	4	6	,,
100 ,, ,, 200 ,, . .	10 per cent. on cost, or special agreement.		
150 ,, ,, 300 ,, . .	,,	,,	,,
200 ,, ,, 400 ,, . .	,,	,,	,,
250 ,, ,, 500 ,, . .	,,	,,	,,
300 ,, ,, 600 ,, . .	,,	,,	,,
400 ,, ,, 800 ,, . .	,,	,,	,,
500 ,, ,, 1000 ,, . .	,,	,,	,,

4. A main cock or tap will be placed on the service-pipe, the lead connections to and from inlet and outlet of meter fixed by the servants of the Company, and charged to the tenant or landlord.

5. No gas-fitter or others will be allowed to remove or interfere with, connect or disconnect any gas-meter or service-pipe, unless a written authority, signed by the Manager, be given in special cases, or in cases of emergency, where there is a possibility of immediate danger, when notice must be sent to the office as soon as possible.

6. A written application to be made at the gas offices for a meter by intended consumer, or the gas-fitter, certifying that he has personally examined the gas-piping, &c., and that they are put up in a sound and workmanlike manner, stating about the number of burners to be supplied, and also whether there is or not a probability of increased number being required at any future time.

7. The outlet or leading main from meter to lights not to be less than ¾-in. bore, lead or composition pipe, and must be carried to the ceiling, after which, if fitter thinks proper, it may be somewhat diminished in bore. Quarter-inch piping should only be used for short branch-pipes from the leading main, and fitters are recommended to discountenance its use as much as possible.

The following scale of dimensions for mains should be strictly adhered to. You are also recommended to use strong and substantial piping:—

1 to 4 lights . . .	¾ in.	lead or composition.
4 to 10 ,, ...	⅞ in.	,, ,,
10 to 15 ,, ...	1 in.	,, ,,
15 to 25 ,, ...	1 in.	,, ,,
25 to 35 ,, ...	1 in.	,, ,,
35 to 50 ,, ...	1¼ in.	lead or iron tubing.
50 to 70 ,, ...	1½ in.	,, ,,
70 to 100 ,, ...	2 in.	,, ,,
100 to 140 ,, ...	2½ in.	,, ,,
140 to 300 ,, ...	3 in.	,, ,,

8. In fixing the pipes, particular care must be taken to give them a gradual fall to the meter or water-slide pendant. In all cases where it is practicable, all downward bends or hollows in the pipe, where water might collect, must be particularly avoided; but, in cases where they cannot possibly be avoided, a small cock must be fixed at the lowest part of the bend or pipe, so that any water which may accumulate therein may be drawn off.

9. No self-acting syphons, or bent tubes, open at end, must in any case be attached to the pipes for the discharge of water.

10. All lead piping under floors, where possible, to be laid on wood strips, securely nailed to the floor joists, and to have a proper incline; and all chandeliers or centre fittings to be fixed with wrought-iron or brass connecting pieces and back nuts.

No authorized gas-fitter must lend his name to any unauthorized person for the purpose of obtaining meters, and getting service-pipes laid, nor certify any fittings which he has not personally examined, as it would be contrary to the regulations laid down by the Gas Company for the protection of the public.

12. Any authorized gas-fitter refusing or neglecting to comply with, or committing any breach of, the foregoing regulations, will subject himself to be reported to the Directors, and struck off the authorized list.

By order of the Board of Directors.

JAMES DALGLIESH, Manager.

Gas-Works, Glossop, May 27, 1878.

The taps which have been produced are at the inlet of the meter, and the effect of their being out of order would be a loss to the Company. I do firmly believe that the reason why fully one-third of the inhabitants, and some of the mills, decline our gas is because of the wretched state of these taps. I have heard no complaints as to the price during my term of management, and I can testify that we have been commended for the supply we give. I am told there is a similar case where a full third of the inhabitants declined to take the supply of an existing Gas Company—viz., Aberdare—and I dare say many more could be looked up. The maximum price at Ashton, which was fixed in the session of 1877, is 3s. 8d. We require 6s. as against 3s. 8d. in Ashton, because we are not so favourably situated in many respects. Ashton has the advantage of the auction clauses, which they took upon themselves voluntarily in 1847, and practically, out of a capital of £59,655, £12,185 was premium, so that the actual dividend capital was £47,000. We are now proposing to adopt the auction clauses. Ashton is also much more compact, and the consumption per mile of main is much greater, whereas in Glossop we have only 100 consumers for every mile of main, or a consumption of 1,360,000 feet, while the general rule laid down is 2½ million feet per mile. There are four very large firms which make their own gas, simply because they had the plant there before the Company commenced in Glossop. We have not succeeded in inducing them to think it more advantageous to take our gas, but I believe one or two of the firms would find it to their advantage to have it from us. The leakage last year—21 per cent.—was extraordinarily large, owing to the severe winter we had. If what is consumed on the works is also taken, it would amount to 22·90 per cent. I may say here, that the leakage from the lamps of the Corporation goes to swell our leakage, through their leaving the taps open, and putting on larger burners than they specify in their agreement. I believe the average price at which we sold gas to the Corporation last year for public purposes was 4s. 1·8d. We have the means upon record of saying what the illuminating power from time to time has actually been. In my time it has varied from 16 to 18, but I propose to keep it at an average of 16. The maximum fixed at Ashton is 16. I do not know the maximum at Hyde, but they profess to supply 16-candle gas. The price at Ashton is 3s. 8d. We want a large amount of capital, in order to provide for the increasing wants of the district, and I think the sum for which we are asking will enable us to remain, perhaps, for 15 or 18 years without coming to Parliament again. We have no land at present unoccupied, and are rather inconveniently crowded in the depth of winter. When the coke is deposited in the yard we positively have not room for our ordinary working. Of course, in the winter season, the quantity of coke accumulates very largely, which makes it necessary for us to have additional works at another place, because on our present site we have no room for more gasholders. Last year we had an excessively

severe winter, which broke a great many of our mains; but I believe that was generally the case with companies. The leakage the year before was 18 per cent.

Re-examined by Mr. MICHAEL: We work upon the average meter system, and test several lamps by the indication given by one. Unless the burners are exactly the same, it results in loss to the Gas Company and not to the consumers. We are doing our best to remedy that, but it will require a large expenditure of money in the way of laying new mains.

By the COMMITTEE: We obtain our coal from the Yorkshire district, and I should say it has to come a little over 20 miles. Glossop is about 6 or 6½ miles from Dukinfield, but they are in the centre of a coal district. We do not get our coal from that district, because we can get it cheaper from the Yorkshire district by rail. We depend entirely upon the railway.

By Mr. MICHAEL: We could bring the coal by rail from Dukinfield, but we purchase it on more reasonable terms in the Yorkshire district. We have now about 30 miles to bring it. The average price is 12s. 11d.

Mr. *D. Clarke*, examined by Mr. MICHAEL.

I am at present Engineer and Manager of the Ashton Gas-Works, but was Manager of the Glossop Gas-Works from 1870 to 1876. During the time I was Manager, I endeavoured to satisfy the wants of the public, and to supply a good quality of gas, and I think I gave an average quality of over 16 candles. For the 15 candles mentioned in the Act, 16 candles must still be given. I think it would be better that the works should be removed out of the immediate district of houses in the centre of a town. The present ground is much occupied with plant. The district is a very straggling one, and that leads to further expenditure in the supply of gas. One of the main elements in considering the price is the number of customers on each mile of main. I think the existence of fittings such as those produced has been a very serious drawback, and persons have been unwilling to spend money in putting up fresh fittings. It is not a very exceptional thing to have one-third of the inhabitants not taking gas at a place like Glossop; there is no district where everybody considers gas to be the proper thing. I think the capital which is asked for in the present Bill will be expended within 15 or 20 years. The Company are very much in want of capital now; in fact, I should imagine they want something like £5000 immediately. I think the price at present charged is very reasonable, and I do not see why it should be altered. There has been a great difference in some years as to the price charged for coal, and during my time it was 24s. 9d. per ton, which led to a very large increase in the cost of supplying gas. I do not remember the date when the Hyde Bill was obtained, but they have a maximum of 6s. there. That is the next town to Glossop, and the illuminating power is not specified, but they supply 15 candles.

Cross-examined by Mr. ASPINALL: The net price at Hyde ranges from 3s. to 4s. 3d. I said in the House of Commons that 5s. 6d. at Glossop would do; but to-day I say I see no reason why the price should be altered, seeing that Parliament have thought fit to grant them 6s. If the Directors had broken faith with the consumers, then, of course, I should draw attention to it. I still consider that, under ordinary circumstances, 5s. 6d. would do; but there are exceptional times.

By the COMMITTEE: At present the price is very much below the maximum. The difference between the present price and the maximum price of 6s. does not give them more than a balance for contingencies. With regard to the difference between 3s. 8d. at Ashton and 5s. 2d. at Glossop, it must be understood that there is 5d. off at Glossop, so that it is 4s. 9d. The price at Glossop is from 3s. 11d. to 4s. 9d., and the difference arises in this way: at Ashton we have had the auction clauses since 1847, and we have had a capital that has been realized by our premiums, and does not bear dividend, of about £20,000. The capital bearing dividend is only about one-half that of Glossop per 1000 feet; we have double the amount of consumers per mile of main; and, the district being compact, our leakage is much less. At Ashton we have a sliding scale, ranging from 2s. 11d. to 3s. 5d.

Mr. *G. W. Stevenson*, examined by Mr. RICHARDS.

I have made myself acquainted with the position of the undertaking of the promoters, and have examined the gas-works at Glossop and the district supplied. It is proposed to take power to raise £40,000 of additional capital, and, if that power be granted, it will last, perhaps, from 15 to 20 years. That is slightly longer than the usual time, but this is a small Company. The introduction of auction clauses renders the amount of capital absolutely unimportant, except that, if a very large amount of capital is granted, it makes the Company independent of an application to Parliament for a longer term than if the amount is less. For a small Company like this, the application to Parliament, opposed as it has been, and is, will cost 5 per cent., at least, of the new capital, upon which the consumers of gas will have to pay a dividend. Under the suggestion of the House of Commons, it is proposed to give an illuminating power of 15 candles, which is one candle more than usual. Such important towns as Exeter, Lichfield, and York, in the last session had 14 candles inserted, and I should think what was good enough for those towns is good enough for Glossop. We propose to leave the price as it hitherto has been. I should like to explain that the maximum price inserted in an Act of Parliament is a price which is intended to provide a margin beyond the actual necessities of the Company, so as to meet any contingency. It is not like a standard price, which has been inserted in some modern Acts, with power to the Company to go up or down, above or below that standard price, and to suffer a diminution when they go up, and get an increase of dividend when they go down. The maximum is a price beyond which they cannot go at any time, and under any circumstances whatever, and, therefore, there must be a considerable margin. The gas of this Company costs them, at the consumers burners, 4s. 7d. per 1000 feet. If the dividend be added upon £4000 of additional capital which they ought to expend immediately, it will bring it up to 4s. 9d. per 1000 feet. I do not think the difference between 4s. 9d. and 6s. is greater than has been usually granted by Parliament when a maximum price has been inserted in an Act. With regard to the capital asked for, I see that the petitioners state that, in their opinion, the additional capital ought not to exceed £10,000. Their own skilled witness in the House of Commons said that if the Company had inserted £20,000 in their Bill, he should not have opposed it, and I do not think it at all natural for the Corporation now to say £10,000. They also say the standard ought to be raised to an illuminating power of 18 candles, which I think would be very improper indeed.

Cross-examined by Mr. ASPINALL: The illuminating power is 16 candles at Ashton; at Blackburn, 16; at Bolton, 16; at Fleetwood, which is more accessible to the cannel district, 16; at Hindley, 16; and it is the same at a good many other places. There are instances where 30 candles is inserted as the minimum illuminating power, but it would not be proper to do so in Glossop. Ten to fifteen years is generally allowed to companies before again applying to Parliament, and if this capital were cut down to £30,000 instead of £40,000, it would be the usual amount of capital granted to last the usual time. I presume the object of that practice is to give the consumers and local authorities the opportunity of making any complaint which they may have to make, and other things. When I say the cost of an application to Parliament is 5 per cent. on the capital, I mean if there is an opposition, which implies a real or a fancied grievance. I do not think the necessity for coming to Parliament operates as a check upon companies to make them do rightly. My experience is that they endeavour to do the best they can, as a rule; it is quite exceptional when it is otherwise, both for themselves and for their consumers, because their interests are identical. I make out that the cost of gas delivered to the consumer is 4s. 7d. per 1000 feet, by taking it from the last annual accounts of the Company. The cost of coal, cannel, and lime is £3049, less residuals (that is coke, tar, ammoniacal liquor), £1138, which, deducted from that amount, leaves £1911 as the net cost of the raw material, and that is equal to 15·34d. per 1000 feet. The working expenses are £2553, equal to 20·49d. per 1000 feet; and the interest on loans, bankers commission, and so on, is £293, equal to 2·35d. per 1000 feet. The total is £4756, equal to 38·18d. To that must be added the dividend on £9000 of capital, at 10 per cent., and on £16,000 of capital at 7¼ per cent., making together £2115, equal to 16·97d. per 1000 feet; or £6871, equal to 55·15d. for the whole. Then the Company want to expend immediately £5000 or £6000, in fact, but I estimate they will attain their end by issuing £4000 at public auction at 7 per cent., and that will add another £280, equal to 2·24d., making the total cost of the gas £7151, or equal to 57·39d. per 1000. I therefore consider that, looking at the present low cost of coals, labour, &c., 5s. 6d. is the lowest maximum that could safely be inserted, if any alteration is to be made in the present maximum of 6s. Then there is gas produced, 38,750,000 cubic feet; sold, 29,899,000; used, 555,000; making together 30,454,000 cubic feet, showing 21½ per cent. lost, equal to 8,300,000 cubic feet; so that, if the cost of coals and labour should go up, that price will go up, and the required selling price will go up. I do not see any reason at all why the present maximum should be disturbed, because the Company are not now charging that maximum price, and will not be permitted to do so in the future, owing to the operation of the Gas-Works Clauses Act, which limits their powers. If they attempt to do so, they can be indicted by the local authority before the Court of Quarter Sessions, and very severely punished. I do not know whether the Company have latterly been paying back dividends.

Mr. RICHARDS said that was the case for the promoters.

Mr. ASPINALL stated that he would call his witnesses before addressing the Committee.

Mr. *T. M. Ellison*, examined by Mr. BROWNE.

I am Town-Clerk of Glossop, and also Clerk to the Borough and County Justices. I produce a requisition for calling a meeting of ratepayers, for the purpose of determining whether the opposition by the Town Council should have the consent of the various owners and ratepayers of the borough, and it is signed by all the leading gentlemen and manufacturers of the district. The feeling at the meeting was unanimous, with the exception of a very infinitesimally small number of persons, and then there was a poll, due notice of which was given. At the poll the numbers were, for the Gas Company, 165, against 2475 who voted in favour of the opposition. We have the approval of the Local Government Board in our opposition to the Bill. As regards the taps which have been produced, the evidence that has been brought before the Committee is of a very slight character, because Mr. Dalgliesh has only been Manager in Glossop for two years, and he cannot say how they came to be put down. I have looked at my own gas bill, and I find that the Company's regulations, so far back as 1867, were that they have the command of all services, and that the Company only were to supply them, and they gave the names of a number of private persons to whom the cottagers could apply. I have another sample [produced] which, I think, is rather better than the one shown on the other side. If the poor people have these taps, they do not like to pay over again for the same outside service in a new and amended form, and therefore the refusal to take the gas has arisen from the Company's own neglect, in not attending to their duty, and seeing that the first fittings were properly fixed. During the time I have resided at Glossop the quality of the gas has been a very sore subject of complaint, until some short time before the intention of applying to Parliament for the present Act became known; but there has been a slight improvement during Mr. Dalgliesh's management, for which we must give him every credit. During Mr. Clarke's management — especially during the time when they say they were not charging the maximum price—the gas was exceedingly bad. I have burnt the Company's gas, and also a petroleum lamp for my own reading in the evening, because the Company's gas was insufficient. I had three lights in the room, and they were not enough to read by comfortably, and I therefore had a lamp as well. In 1874 a public meeting was held, at which the following resolution was unanimously carried:—"That, in the opinion of this meeting, the Glossop Gas Company do not afford the inhabitants of the borough a supply of gas of such illuminating power as is necessary for domestic comfort, for working purposes, and for the proper illumination of the streets; and that such supply as is afforded is of an inferior quality, and sold at an excessive price." That meeting represented the feeling of most of the inhabitants when the resolution was passed. Lately—since the Bill was read a second time in this House—we wished Mr. Penny to see the works, and a short correspondence passed; but, acting under advice, the Company refused to allow it. There is no ill-feeling about it, but it is the fact that they did refuse. I have in my possession the Company's accounts for some time past, and for the last year particularly, which indicates that they have been paying up back dividends. Those accounts show that they have paid towards arrears of past dividends the following sums:—£210, £105, £130, £135, and a balance of £95 carried over. That is the profit they had by their present price of 4s. 9d., with a discount I should observe that the particulars with regard to the discount were not at all carefully stated in the Lower House. It was stated to be, "If paid within a month;" but it should have been, "If paid in the month of issue." The Company send their accounts out in January, and in one case the Corporation had only three days in which to pay to obtain the discount, but that was an extraordinary case. The Manager admitted that it would take them some time to send the accounts out, and I think it may be taken that it is more an average of 14 days than a month. I should say that there are no greater difficulties of supply in the case of Glossop than there are at Hyde; and as regards the Dukinfield coal-pits being nearer to Hyde, that does not signify at all, because it is a matter of competition among the collieries, and the Yorkshire and Dukinfield collieries will compete with one another to deliver, whether the place may be nearer to one or nearer to the other. For instance, I have heard of Dukinfield collieries selling coal to the Manchester Corporation, and delivering it at a lower price than they delivered it to Ashton-under-Lyne, which is nearer. The price of gas at Glossop ought not to be higher than at Hyde, or at all events not more than 1d. or 2d. per 1000 feet. I think a less maximum than they seek to continue by the Bill would be sufficient, and if I were a shareholder I should be satisfied with a less maximum. I believe that, if the price were reduced, there would be a larger sale of gas than there is at present, and I do not think I should be wrong, from what I know of public feeling, if I say that if it is not reduced there will be a very great reduction in the consumption. With reference to the new site, there is a piece of land behind the gas-works, which joins the wall on the north side, and which can be conveniently taken. Then there is a private road, and at the other side a brick-field, and it would be very easy indeed for the Company to take in this

land, and communicate across the road, and have their storeage room on the site where the brickfield is.

The CHAIRMAN said it was a waste of time to go into that matter.

Mr. RICHARDS said he should not cross-examine the witness.

MONDAY, MAY 12.

Mr. *Alfred Penny*, examined by Mr. BROWNE.

I have visited Glossop, and examined the whole district supplied by the Company, and, though I have not been inside the works, I have noticed their position. An application was made for my admission to the works, but permission to visit them was refused. I have made myself acquainted with the provisions of the Act which governs the proceedings of the Company, and have inspected their balance-sheets for the two half years ending June, 1878, and Dec., 1878. I have been under the impression that these accounts and the figures connected with that year were the only matters that were before the Committee, and that that really was the period which was being dealt with, as it is the most recent time to which the Company's accounts were made up. I have here a statement, which is very short, and which will probably save some difficulty [handing in the same].

Mr. RICHARDS: Am I to understand that this is an analysis not referring to the period of Mr. Stevenson's analysis.

Mr. BROWNE: It is exactly the same period that Mr. Stevenson took.

Mr. RICHARDS: No; Mr. Stevenson took the year ending June 30, 1878.

Witness: There has been just this difficulty, that Mr. Stevenson took the quantity of gas made to June 30, 1878, but he took it wrongly, because he should have taken these 8 millions that have been dealt with all through this case as the quantity of gas sold to Dec. 30, 1878. He was, therefore, dealing with the wrong quantity of gas, which, as a matter of course, the divisor being different, compelled him to show that the cost of gas was greater than it is.

Mr. MICHAEL: I ought, I think, at once to state that there is an error. Mr. Penny is right, although he has put it wrongly to your lordships. Hearing that Mr. Penny had made a difference, and knowing that he is usually very accurate, I have taken the trouble, with Mr. Stevenson, to go over the accounts, and I find that Mr. Stevenson has made an error (which I mentioned to Mr. Penny before I came into the room) of 2d., in taking a wrong divisor. He has not exactly done what Mr. Penny states; he has taken the published accounts of the Company for the financial year, but he did not take a proper divisor, which works out 2d. in our favour; and to that extent Mr. Penny is right, and we are wrong. I take the earliest opportunity of informing your lordships of that mistake.

Examination resumed: In that period the figures work out as follows:—There have been made 38,784,600 feet of gas. The quantity sold is 29,889,600 feet, and the unaccounted-for gas is 8,885,000 feet, leaving a loss by unaccounted-for gas of 22·90d. That does not quite correspond with the amount stated by the other side, but a portion of it is used in the works, and therefore it approaches rather nearer than they say. The receipts for the whole year for gas and meter-rents is £7095 9s. 10d.; the expenditure for coals, labour, salaries, and working expenses of every kind, amount to £3693 1s. 2d., and the sum paid for interest on loans is £308 19s. 3d., making £4002 0s. 5d., which, deducted from the receipts, leaves a sum in the shape of balance of profit for the year of £3093 9s. 5d., which, worked out into the cost per 1000 feet as sold, is 2s. 0·83d. It requires, to pay the maximum dividend per 1000, 1s. 2·09d. I may explain here that these are the actual figures in the Company's accounts. I am informed that they are turning a certain amount of borrowed money into share capital, and that borrowed money is now, I suppose, charged at 5 per cent., or 4½ per cent., or something of that sort, and a further sum will be required when this arrangement as to the share capital, which takes 7½ per cent. dividend, is carried out, as it will then require a larger sum than 1s. 5d. to pay statutory dividends. This is what was required in 1878, and, having made that explanation, it will be dealt with, no doubt, in a proper way. That leaves a surplus profit of 7·74d. per 1000 cubic feet sold, after the statutory dividend and interest on the borrowed money is paid. I may say, in passing, that represents £964 in money. I think Mr. Dalgliesh stated that the leakage amounts to nearly 22 per cent. I do not think I should be doing my duty to those who employ me if I did not point out to the Committee that in well-conducted works the leakage ought not to be more than 10 or 12 per cent. I say, therefore, it is not a fair thing to take a leakage of 22 per cent.—which represents a large sum of money—as an element in estimating what the price of gas should really be, because there is nothing to prevent them next year from reducing that leakage to a nominal amount, and thereby increasing the profit, and lessening the cost of gas. Supposing that were done, I should say that there is at least 3d. that might be fairly taken from the cost of the gas, and which would, of course, increase the amount of profit; 3·34d. is the exact figure it would come to, even taking it at the smaller amount of leakage—namely, 21·30, when it is really a little more, and this would leave a surplus profit of 11·8d., which represents a sum, in round numbers, of £1380.

By the CHAIRMAN: There would be that surplus if they reduced the leakage to a normal amount—that is to say, to 10 or 11 per cent.—which would be applicable for any purpose they might think it necessary to apply it to; for instance, they might reduce the price of gas, or fill up the reserve-fund, or it might be applied for the general purposes of the Company; so that there is really in this account nothing hypothetical except the amount. I say they can save, and ought to save, by reducing the leakage. The 11·08d. remains after payment of working expenses, and interest on loans and on capital. It is brought out by an analysis of the Company's accounts for the year 1878.

The CHAIRMAN: Upon what figure do you say that 11·08d. ought to remain? Is it upon what is actually being charged for gas?

Witness: It is what is being actually charged for the gas, because I am dealing with the Company's receipts and expenditure, as set forth in their own printed accounts.

And what has been charged for gas, you find from their accounts has been 4s. 8·95d.?—No; 4s. 1·16d. The other is the amount they have received—4s. 8·95d., or, in round numbers, 4s. 9d. To do what I have stated to the Committee—that is, to pay for the coal, and to pay for labour, and maintenance of works, and pay the dividend—takes the sum of 4s. 1·16d. In my experience, whether a Bill goes before Lord Redesdale as an unopposed Bill, or whether it is discussed or dealt with before a Committee, there is generally—in fact, I may say always—some proportion preserved between the cost of the gas and the maximum price the Company are allowed to charge; and in this case, having regard to all the circumstances, I think 4s. 6d. would be a fair price to put in as the maximum. According to my figures, unless I am shown to be wrong, they would then have more than 6d. per 1000, which would enable them to fill up their reserve-fund, and if another coal famine should come, or any other contingency happen, they would still have such a reserve that they might draw from it to pay their maximum dividend. I am never desirous of pushing a company close, whichever side I happen to give evidence upon, but I think there is sufficient in the 4s. 6d. to enable the Company to pay their maximum dividends, and also to struggle against those contingencies which no doubt do and will happen. I do not think it would be any hardship upon the Company to fix a standard of 16 candles instead of 15 for the illuminating power of the gas to be supplied. The Manager of the Company stated that they use two-thirds coal from the Yorkshire districts, and one-third cannel. The cost of that coal and cannel in those proportions must have entered into the Company's accounts, and therefore I think there ought to be no difficulty whatever in preserving a standard of 16 candles or more. From the book kept by the Company, containing the record of the illuminating power, I find that in January, 1878, the illuminating power was 18·70; in February, 18·00; in March, 18·00; in April, 17·90; in May, 19·40; in June, 18·50; in July, 17·70; in August, 18·00; in September, 18·80; in October, 18·00; in November, 17·90; in December, 17·90. Then for 1879 the illuminating power was in January, 18·06; in February, 17·90; in March, 17·70; in April, 17·10. I have had very considerable experience in the use of Yorkshire coals, and I know, from the returns which are sent to me by the various companies for whom I act, that 16-candle gas can be obtained from Yorkshire coal alone. If so large a proportion of cannel coal is used by this Company, there should be no difficulty in making that quality of gas, and I really think that a standard of 16 candles might very fairly and properly be put into this Bill. The average of the figures given comes out 18·09. I admit there should be a margin given to companies in respect of illuminating power, because they cannot fix themselves exactly to a standard; therefore I have no difficulty in saying that in my opinion 16 candles would be a fair standard to insert in the Bill. I stated in evidence last week that the difference between the illuminating power produced from Durham coal and Yorkshire coal is something like two candles, and if this were a district where Durham coal is used, I should lower my standard two candles at least; but here they are, in the heart of the Yorkshire Silkstone district, and it would be the most proper coal for them to use. With regard to the new capital, I think, looking at all the facts of the case, that if £30,000 were inserted, instead of £40,000, it would be a liberal thing—that £30,000, of course, to include the premiums. I know that, by clause 6 of the Bill, the Company seek power to purchase land and erect works for the manufacture and storeage of gas upon the new site, which is described in the schedule to the Bill. As I was not allowed to inspect the works, I am hardly in a position to say that they ought not to have that land, because I did go round it, and thought it appeared to be rather crowded, as has been described. However, I saw a field, which was only divided from the gas-works by a road, which, if obtainable, would, in my judgment, be very suitable for the purposes of the Company; but I do not know anything about the circumstances, and whether they can get that land or not. I believe, also, that the acquisition of that land would not be objected to by the Corporation of Glossop.

Cross-examined by Mr. MICHAEL: I am not in a position to say whether the Company require more land or not, as I have not seen the interior of their works. In the total sum which I have put down, I take, in round numbers, 300 million feet as the quantity sold, and the difference of 2d. arising between myself and Mr. Stevenson gave me very great trouble, because I have generally found Mr. Stevenson so accurate that I was more inclined to believe that I was wrong than that he might be. He pointed out to me that he had made a mistake, but not till this morning; he honestly believed before that he was not labouring under a mistake. In my account I have included £434 of meter-rents, which is usual in gas company's accounts; in fact, I never saw one which did not include that item. In ascertaining the net cost of gas, I do not put meter-rents in as a credit, but I take the company's receipts, which are applicable first to pay the expenditure, and then the dividend, which very likely comes to about 4d. per 1000 feet, but I have not calculated it. Whatever life meters have, they are maintained out of the yearly expenditure, and when a meter dies another one is substituted for it, and the cost is put into the yearly expenditure. I have put down 1s. 5d. as the amount required to pay the maximum dividend on the capital of £9000 at 10 per cent., and on £32,950 at 7½ erp cent., which works out to a total sum of £2621.

Mr. MICHAEL: Dividing that by 29,899,000 feet of gas made, I find it works out to 1s. 9d. as against your 1s. 5d., or a difference of 4d.

Witness: What I have had as the foundation of my figures is the company's accounts, and they say that a sum represented by 1s. 5·9d. pays their statutory dividends.

Did pay?—Did pay to the end of 1878, and that there was a further expenditure.

Is it not to the end of their financial year—viz., June 30, 1878?—I do not know. I cannot follow your figures, because you take them in a different way from mine.

You agree as to the amount of capital, the amount of dividend, and as to the total sum required—namely, £2621. Take 30,000,000 feet instead of 28,899,000, and you see it comes to the sum I have given you—viz., as against your 17d.?—Yes; but there is one thing I think you have omitted to do. We have a sum of £308 19s. 3d. as interest on loans.

That is a totally different matter. Interest on loans cannot be dividend; you must take that out altogether before you come to profit. Take the £2600, leaving out all the other, and divide it by 30,000,000, and you will see that it comes out to 1s. 9d. as against your 1s. 5d.?—I do not see that I am compelled to admit that I have made an error.

The figure that I have here as a sum sufficient to pay the maximum diviend is £2129 10s. 6d., but that refers only to capital that has been called up.

But you have not the proper amount of the capital called up. That is the mistake you make.—My account takes the capital that is stated in the Company's balance-sheet.

That is the antecedent capital, but you are aware that capital is continually being called up by the Company?—Yes.

Cross-examination continued: What I am prepared to admit is, that so soon as the Company have turned their present borrowed money into share capital, they will require a larger sum than 1s. 5d. to pay their maximum dividend. The total unaccounted-for gas is 22·9. It is not leakage, because I have taken out the quantity of gas which has been used on the Company's works, and that reduces it to about 21 per cent. I have not taken credit in my account as though it was only 10 per cent. instead of 21 per cent. Before the Company can diminish the leakage, a very considerable sum of money must be spent in order to put the mains, from which that leakage arises, in a proper condition. I have allowed nothing for that expenditure, because it will come out of the annual maintenance of the works. Supposing the account to be true which has been given of the illuminating power, I think the Company have dealt very fairly and liberally in supplying 18-candle gas, also by not charging the maximum price, although they have made a large profit by charging a much less sum. I am aware there is something of their maximum dividend left unpaid, but if they had reduced the leakage they would have had more profit, which might have enabled them to reach their maximum dividend long ago. I have been assuming that the leakage did not arise from small mains so much as from mains in a defective condition. The Manager of the Company said he had some broken mains, and so on; so that it appears to me to be a thing very easily remedied. I should not advise, if a main was taken up in a district of this kind, that another one of exactly the same size should be placed there. Before leaving the subject of leakage, I should like to state that I hold in my hands the annual report of a company for whom I am Engineer, and

whose Bill I got through Parliament, and there is actually here a statement—although it seems almost incredible—following two years one upon the other, which shows a loss, in the shape of unaccounted-for gas of only 2·49 per cent., and I therefore say that 10 per cent. is a fair amount of leakage. I do not consider that 10-10ths of pressure is a very high figure to supply the various parts of the district, but 32-10ths is exceptionally high. In their expenditure, the Company have provided for coals giving gas of an illuminating power equal to over 18 candles, and therefore I say that, as I am dealing with the Company's figures, it will not be a great hardship if they are asked to give 16 candles as the standard, when they can easily provide 18. If they choose, they can very easily reduce the cost of coal by reducing their present standard, even if they get 16 candles in the Bill. Somewhere about 80 per cent. of all the companies in England have a standard of 14 candles, but the greater proportion of those standards are fixed by reason of the companies having to supply themselves with coal from the Durham coal-fields. Since railways have run throughout the kingdom, a good many places can get the Yorkshire coals, where they could not get them before; but I deal with this place on its own merits, and I say they are within reach of coals that will enable them to give a higher standard than a place which is not so favourably circumstanced.

Re-examined by Mr. Balfour Browne: Meter-rents are, of course, a part of the receipts of the Company, and therefore it is right to place them on the credit side of the accounts, because the capital that they have to pay dividends upon has been used for the purchase of those meters. With regard to the 1s. 5d. it takes to pay the maximum dividend, I have arrived at that figure by taking the very sum the Company say they have spent; but I admit freely that, if they turn this borrowed money into share capital, there will be—supposing they borrowed money at 5 per cent. and pay 7½ per cent. upon the new share capital—a sum of, perhaps, 1d. per 1000 required to pay the increased dividend upon the new share capital, which had been borrowed money before.

Mr. *T. Newbigging*, examined by Mr. Browne.

I have been in the room during the examination of Mr. Penny, and know that by this Bill it is proposed to have a maximum price of 6s. per 1000 cubic feet, which I think is higher than ought to be permitted by Parliament under the circumstances the Company are placed in. I have been able to form an estimate, by going over the accounts, of what would be a fair maximum price, and I agree wtih Mr. Penny that 4s. 6d. would be a fair price. I have made an analysis of the Company's accounts for the year ending Dec. 31, 1878, and I find that the cost of coal——

The Chairman: I do not think you need go any further into this.

Examination resumed: I think the price of 4s. 6d. would give the Company an ample margin for any contingencies arising in the price of coal or labour. I have formed my opinion entirely independent of Mr. Penny, and gave my evidence in the other House upon the same basis. I think the minimum limit of illuminating power should be fixed at not lower than 16 candles; in point of fact, 17 candles to-day are only what 15 candles would have been a few years ago, before Mr. Sugg invented his new "London" burner, by which the testing of gas is now performed under most Acts of Parliament. I have compared the minimum illuminating power fixed by the special Acts in certain northern towns situated like Glossop.

Mr. Browne: What do you find them to be?

Mr. Richards said he would take the opinion of the Committee whether it was worth while to go into that question, because if so he could produce sixty instances in which there was 14-candle gas.

The Chairman said he did not think it necessary to go into these cases.

Examination continued: I have considered the question of capital, and am inclined to think that £30,000, if it were allowed to include premiums, would be an ample sum for the Company.

Mr. Balfour Browne said that was the case for the petitioners in opposition to the Bill.

Mr. Aspinall then addressed the Committee on behalf of the petitioners, complaining that the quality of the gas had hitherto been bad, and urging that the amount of fresh capital should be limited to £30,000, that the price should be only 4s. 6d., and that the illuminating power should be raised to 16 candles.

Mr. Richards having replied for the promoters,

The committee-room was cleared. On the counsel and parties being re-admitted,

The Chairman said the Committee had decided that the capital should be reduced to £30,000, instead of £40,000, which was merely reducing it by £10,000, including the premiums; that the illuminating power of the gas should be left as it was in the Bill—namely, 15 candles; and that the maximum price be reduced from 6s. to 5s.

The clauses of the Bill were then read and agreed to, and the Chairman was directed to report the Bill, as amended, to the House.

THE SELECT COMMITTEE ON LIGHTING BY ELECTRICITY.

Ninth Day—Friday, June 13.

(Members present: Dr. Lyon Playfair, in the chair; Mr. Alfred Gathorne-Hardy, Mr. Hardcastle, Mr. Mitchell-Henry, Sir Ughtred Kay-Shuttleworth, Lord Lindsay, Mr. A. Moore, Earl Percy, Mr. Puleston, Mr. Spencer-Stanhope, Mr. Talbot, and Sir David Wedderburn.)

Lieut.-Col. *William Haywood*, examined by the Chairman.

I am the Engineer to the Commissioners of Sewers of the City of London. That is the section of the Corporation which has charge of the roads, the pavements, and the lighting of the City. In that capacity I have to deal with the lighting of the City, at present with gas, and should it be desired in future, with any other form of light. For the public gas-lamps there are two prices charged, according to the description of lantern which is employed. The price of the larger number is £4 13s. 3d. per annum, and the others, which are of a more ornamental character, are £4 17s. 6d. per annum. Those charges include the maintenance, lighting, extinguishing, and cleansing. The gas-lamps in London are considered to be lighted for 4300 hours during the year. The cost of that per hour of illumination is about 0·27d., or a little more than a farthing per hour per gas-lamp. We have not received many complaints as to the defective lighting of the City streets. From time to time there are isolated complaints of want of light in particular parts of the City, and those are usually rectified by an additional lamp or so being put up; but generally there are no complaints of want of light in the streets. The traffic in the City is limited to what you may call the hours of business. It begins to get very large at eight o'clock in the morning and at eight o'clock at night it is practically over. I should say that more than 80 per per cent. of the entire carriage traffic, at all events, passes through the City in those 12 hours. So that if a much greater illumination were required, it would only be necessary to have that excessive illumination for a limited number of hours. Beyond that I think it would be waste. The footways are relatively very narrow, and as all the lamps are placed on those footways, there is, in my opinion, ample illumination for the pedestrian traffic at all times. There are exceptional spots where it might be desirable to give additional light; but, speaking of the City generally, I think it is sufficiently well lighted. I have not heard any complaints from the police of want of sufficient light. I am quite certain of this, that if complaints were made they would be instantly attended to; and I should say that if the want had been felt, the demand for extra light would have been made long ago. I think we have sufficient power, without further legislation, to allow any company to lay wires in the streets for the purposes of illumination. In fact, I have no doubt that our powers are now sufficient. There is a special clause on the subject in the Commissioners of Sewers Act. It is the 116th section, and it runs thus: "And for the better lighting of the streets, be it enacted that it shall be lawful for the Commissioners from time to time to enter into contracts with such gas companies and other persons as they may think fit, to supply gas or to light the City by any other mode, and to cause such and as many lamps to be set up in such places within the City in such manner as they shall judge necessary and proper." Then it goes on to state that the Commissioners may arrange the positions of the lamps, and determine the times when they shall be lighted and extinguished, and so forth. Under that power I have not the remotest doubt that they can either themselves do the work, or contract with anybody to do the work of lighting, by any process they think desirable.

Mr. Puleston: Has there been any subsequent legislation to interfere with that power?

Witness: None that I am aware of. There have been powers confirmatory to a certain degree of the powers of the various Gas Companies, but none which interferes, I believe, with the right of the Commissioners to light the City by any process they think best for the public interest.

Examination continued: I visited Paris to examine into the subject of electric lighting last September or October, and reported at considerable length upon the system which I saw there. I then advised the Commissioners, looking at the public interest which was felt in the subject of electric lighting, to make a full experiment of it on the Holborn Viaduct. That experiment lasted for exactly three months. The Commissioners entered into an arrangement with the Société Générale d'Electricité for lighting the Viaduct on the Jablochkoff principle for three months. It was first lighted on Dec. 14, 1878, and the experiment terminated on the 9th of March in the present year. The cost of the lighting itself was at the rate of 10·7d. per lamp per hour; but the Committee should be informed that the Commissioners themselves went to the expense of erecting a shed for the steam-engine, and doing a variety of work to enable the Company to start their apparatus. Practically they went to nearly the entire expense of laying out the system to enable the Company to light the Viaduct. The contract price of 10·7d. per hour was upon the supposition that the experiment was only to be a limited one. Subsequently the Company offered to reduce that price to, I think, 5d. per hour; but the Commissioners, having seen the experiment, came to the conclusion that the lighting should not be continued beyond the three months for which the arrangement had been made. After a discussion upon the merits of the system, the Commission came to that conclusion upon the 4th of March last; and accordingly the three months experiment terminated on the 9th of March. It was considered that the electric light was not sufficiently satisfactory in point of certainty, and in point of economy mainly, to render it advisable to proceed further with the experiment. I may state that the Commission took a different course from that which the Metropolitan Board of Works took, as they thought that there should be perfectly undivided responsibility in the matter. They placed the whole working unreservedly in the hands of the Société, simply saying to them, "We will do these works, establish the system, and you shall work in any way you think proper, we simply paying you so much per night for the lighting." There were 16 electric lamps altogether on the Holborn Viaduct. The total length of roadway lighted was 1500 feet. The lamps were 110 feet apart, measuring them diagonally from each other, and each lamp lighted 888 yards superficial of public way. The width of the Viaduct is 80 feet, which I may say is an unusually wide thoroughfare for the City, and indeed for London, where we have not too many wide streets. There were 86 gas-lamps not lighted when the 16 electric lamps were used. The gas-lamps are about 24 yards apart, and each lights about 164 yards superficial of public way. That is about one-fifth of the area which the electric light illuminated. During the experiment, on four occasions the lights failed. On the 19th of December all the electric lamps were extinguished at 9.20 p.m.; on the 10th of January the whole of the lamps went out at 5.45 p.m., and were not re-lighted until 8 p.m.; on the 17th of January the four lamps on the north-east circuit went out at 11.30 p.m.; and on the 9th of February the four lights on the north-west circuit went out at 11 p.m. Not knowing very much about the electric light, and the certainty of the illumination from it, the Commissioners had the ordinary gaslighter in attendance, so as to light the lamps, and prevent accidents; he lighted them accordingly on those four occasions. I am not aware whether the more modern experiment upon the Thames Embankment has been attended by similar accidents. To the best of my belief they have not met with any accidents of the kind. I have not heard of any case. The causes of the accidents on the Holborn Viaduct, as assigned by the Electric Lighting Company, were these: On the 19th of December they stated that there was some interference with the electrical machines (they did not say by whom, or how, or what); that it was also very rough weather, and five globes were blown off, which prevented the candles from being re-lighted. With regard to the stoppage on the 17th of January, they were unable to account for it. On the 9th of February they stated that it was exceptionally rough weather, that the candles are supposed to have got wet, and the man in charge was careless in not re-lighting them, he thinking it needless to do so at 11 o'clock at night. I may mention that the reports of these temporary stoppages of the lighting were made to the Commission by the City police, who are in the habit of reporting daily to the Commission any serious defects in the public lighting of the entire City. In any case, whether or not it may have arisen from want of experience on the part of the Company starting their works here, the responsibility was clear and undivided upon the Société itself. It was to prevent any dispute upon that point that I thought it desirable that the Company should have their own way, and do exactly what they liked. I made a report at the time, in which I showed that the electric lighting was much more expensive, for equal illumination, than the old system of gas lighting. I dealt with such information as I had. The Commissioners had no photometric experiments made; so I relied for the illuminating power upon the statements made to me by the Société Générale. I had no other information at hand, and therefore adopted that, and I stated in my report, clearly and in plain terms, that it must be taken for what it was worth. I do not think for a moment that the Société desired to make false representations; but still subsequent photometrical experiments have clearly shown that the illuminating power which I, in that report, assigned to the electric light, was very much in excess of the actual illuminating power. I gave the illuminating power of the 16 electric lights on the Viaduct as fourteen times that of the 86 gas-lamps, and with the opalescent globes seven times. But the experiments of the Metropolitan Board, which I take to be perfectly accurate and reliable, show that that estimate was very much in excess of the real light given by the candles. In fact, their experiments show that the naked light of the Jablochkoff candle is equal to 378·1 sperm candles, and that when it is enclosed in an opal globe it is only

equal to 154·9 sperm candles, showing 59 per cent. of loss, and in a frosted globe about 30 per cent. more. The ordinary bat's-wing burner which is used on the Holborn Viaduct for consuming gas, the burner which is used almost exclusively throughout the whole of London, gives a light equal to about 14 sperm candles. Therefore, from those data the 16 electric lights were equal to 2478 sperm candles, and the 86 ordinary gas-burners, consuming 5 cubic feet of gas per hour, were equal to 1204 sperm candles, showing that the electric light, when enclosed in opal globes, only gave about twice the light of the gas-lamps. I may mention to the Committee a fact with which they are perhaps well acquainted, that a variety of observers within the last few months have placed the light from the Jablochkoff electric candles at very various figures indeed. I find one here put down at 700 candles naked, whereas Mr. Keates, of the Metropolitan Board, simply puts it down at 378 naked. Mr. Sugg puts it down at 400 candles, which you will observe is higher than Mr. Keates puts it at; but Mr. Deacon, of Liverpool, on the other hand, who has had considerable experience in these matters, puts it down at 344 candles, which is less. I should have thought, looking at it with the naked eye, that there was a slightly higher illuminating power than that assigned to it by Mr. Keates; but I do not for an instant wish to put my observations against the observations made by him. Certainly, while the electric light was being experimented with on the Holborn Viaduct (and I saw it nearly every night) I came to the conclusion that there was more than double the amount of light than was given by gas. However, as Mr. Keates is perfectly unprejudiced in the matter, I have placed the illumination of the Viaduct, as determined by his figures, before the Committee. The cost of the lighting on the Embankment is 5·73d. per lamp per hour. At that rate the cost of lighting the Viaduct by electricity would be about four times that of lighting it by the ordinary gas-lamps; therefore the Metropolitan Board of Works data bring the lighting of the Viaduct to four times the cost of gas, and double the light is given for it, broadly speaking. I am aware that there are considerable economies being made in the price of the electric candle at the present moment. I was not aware that the reduction was as much as from 4d. and 5d. to 1d.; but M. Jablochkoff, whom I saw in Paris at Christmas last year, told me that he expected to reduce the cost of the candle very largely; and of course that seemed probable, looking to the fact that the manufacture was an entirely new thing. As Engineer of the Commissioners of Sewers, I only want to get the best light, and directly the electric light is sufficiently developed, and the Commission see that they can rely upon it, and that it will be cheaper than gas (for that is what it comes to, after all), it is pretty certain that it will be introduced for lighting the public ways of the City of London; but its reliability and its economy must first be thoroughly well developed, I think, before there is much probability of its being used there.

The CHAIRMAN: You are probably aware that at the present moment the lights are stretching two miles in length from Charing Cross, and are worked from one engine?

Witness: Yes, that is two miles in both directions. I know that the length to which the electricity can be conducted has been very much increased within the last year. When the Société Générale fitted up the lamps on the Holborn Viaduct, they thought they could not rely upon the electric fluid running with certainty more than 1000 mètres.

I was only drawing your attention to the fact that if this is practically sustained for some time, a central station at Charing Cross might light up Paddington?—Certainly; everything within a radius of two miles might be lighted.

So that you would not require so many stations for lighting the public streets?—No; and that would reduce the cost very much. A multiplicity of stations would, of course, very much increase the cost of working.

Mr. PULESTON: You spoke of the expense of the electric light being too great, according to your experience and observations. Has your attention been called to the recent report made by the French Company, the Société Générale?

Witness: No.

You have not read the figures of the large profits that they have made?—No; if they are making very large profits that will immediately develop competition, and we may expect that the cost of the electric light will be largely reduced.

Did I correctly understand you to say that it was, in your opinion, inexpedient to authorize municipal authorities and others to establish electric lighting in the public streets at the present time?—That is my opinion. I think the light is not sufficiently developed to render it expedient to authorize, at any rate, any commercial companies to open streets for the purpose.

Do you think that the experiments could be conducted better by municipal authorities, than by companies or by private individuals?—No; I must confess that I am very greatly in favour of permitting private enterprise to develop everything. Broadly speaking, we owe railways, tramways, and nearly everything that makes life bearable in large towns, to private enterprise. It is, to my mind, doubtful whether any of these conveniences would have been developed by municipal authorities, or by the Government, to the extent to which they have been. That which develops everything in our country is competition. Competition brings with it inconveniences, no doubt; but you will never get a full development of the electric light, just as you never would have had a thorough development of gas lighting, without competition.

Is not gas used as a means of ventilation when it is not required for lighting?—Yes; largely, I think, in many establishments. It is so used very extensively indeed in the City; for instance, nearly all the large banks, and nearly all the large chambers for public meetings, have it; and gas is being very extensively introduced for cooking purposes.

One of the great advantages of the electric light which has been adduced was, that it was free from heat. Do you consider that always advantageous?—From my point of view I should; but two-thirds of the poorer consumers of gas rely upon the heat of the gas for their warmth. You will hear persons in a lower condition of life repeatedly speaking of the warmth that the gas gives them, and of the comfort they derive from it. Of course I regard that warmth as an adjunct of the vitiation of the atmosphere which undoubtedly arises from gas.

Is there any direct means of making a fair comparison between the cost of the electric light and that of gas? As I understand, the gas companies publish their regular reports, and all the items and details are given?—Yes, the whole economy of a gas-making establishment is thoroughly well known. The whole of the details, in fact, of the gas manufacture of London, are thoroughly well known, not only to the Companies, but to the whole world as well; and that has been the case ever since the year 1860, I think.

How do you account for the greater success and the greater freedom from accident of the electric lights on the Thames Embankment as compared with those on the Holborn Viaduct?—I have no means of accounting for it. I know the lighting in the City was very narrowly watched by the City police, who were directed to report accurately every failure of the light. I do not know whether or not that is done on the Thames Embankment.

Is it still your opinion, in view of the greater information and experience that you may have since had, that the electric light in streets is subject to these casualties?—I should think it would be subject to such casualties. That is my impression, but I do not say that the defect would be invincible; I dare say they may overcome it in time; but I confess that I should fear to entrust the lighting of important public thoroughfares altogether to the electric light, with my present knowledge of it.

Do you consider that the Commissioners of Sewers have power enough to authorize the lighting of the streets in the City by electricity?—I have not the slightest doubt of it. There was a notable case in which they allowed the Great Central Gas Consumers Company, before they had obtained an Act of Parliament, to lay down pipes throughout the entire City. That was somewhere about the year 1849; and I believe the Commissioners powers remain intact.

Would you consider it wise to grant these privileges, for instance, of supplying the electric light to shops, and so on?—If it involves the use of the public thoroughfares for the purpose, in my opinion the electric light is not sufficiently developed to justify those provisions being given to any company.

Or to justify those who have the power in exercising it?—I think not. For instance, I should not advise the Corporation to exercise the power.

Sir DAVID WEDDERBURN: You spoke of gas being extensively used for the purposes of ventilation. Is it, as a rule, a satisfactory means of ventilation?

Witness: Yes; it brings the exhausting power to the proper point, which is the roof.

But unless it is very carefully arranged, is it not liable to vitiate the atmosphere very nearly as rapidly as it renews it?—I should say that it is not possible. The products of combustion of gas are the first to go off into the air.

They ought to be, I am aware; but do you find in practice that they are?—Yes, I think so. The sun burners, which were first introduced about 15 or 16 years ago, are very extensively used, indeed, in the City, and if it had been found that the atmosphere was vitiated by them they would never have been introduced as they have been.

They have in some clubs abandoned them, partly on that account, I believe. You are not aware that they have done so in the City?—No, I never heard of any case in which that has been done. I am fitting up one at the present moment for ventilating the laboratory of a chemist. They may have taken them away from clubs on account of their intense ugliness, for they are very ugly, and they make everybody who sits under them appear very ugly, casting all the shadows down.

The CHAIRMAN announced that this completed the evidence proposed to be taken.

The room was then cleared for the Committee to deliberate; and they agreed to, and presented to the House, the following

REPORT.

The general nature of the electric light has been well explained in the evidence of Professor Tyndall, Sir William Thomson, Dr. Siemens, Dr. Hopkinson, and others. It is an evolution of scientific discovery which has been in active progress during the whole of this century. Essentially the electric light is produced by the transformation of energy, either through chemical or mechanical means. The energy may be derived from a natural force, as, for instance, a waterfall, or through combustion of a material in the cells of a voltaic battery, or of fuel in a furnace. The energy being converted into an electric current, may be used to manifest electric light by passing between carbon points, or by rendering incandescent solid bodies, such as iridium. A remarkable feature of the electric light is, that it produces a transformation of energy in a singularly complete manner. Thus the energy of one-horse power may be converted into gaslight, and yields a luminosity equal to 12-candle power; but the same amount of energy transformed into electric light produces 1600-candle power. It is not, therefore, surprising that, while many practical witnesses see serious difficulties in the speedy adaptation of the electric light to useful purposes of illumination, the scientific witnesses see in this economy of force the means of great industrial development, and believe that in the future it is destined to take a leading part in public and private illumination. There is one point on which all witnesses concurred—that its use would produce little of that vitiated air which is largely formed by the products of combustion of ordinary illuminants.

Scientific witnesses also considered that in the future the electric current might be extensively used to transmit power as well as light to considerable distances, so that the power applied to mechanical purposes during the day might be made available for light during the night. Your Committee only mention these opinions as showing the importance of allowing full development to a practical application of electricity, which is believed by competent witnesses to have future important bearings on industry.

So far as the practical application of the electric light has already gone, there seems to be no reason to doubt that it has established itself for lighthouse illumination, and is fitted to illumine large symmetrical places, such as squares, public halls, railway stations, and workshops. It is used in Paris for lighting shops which require a light by which different colours may be distinguished, and has recently been used in England for the same purpose with satisfactory results. Many trials have been made for street illumination with greater or less success.

Compared with gas, the economy for equal illumination does not yet appear to be conclusively established. Although in some cases the relative economy for equal candle power is on the side of the electric light, yet, in other cases, gas illumination of equal intensity has the advantage. Unquestionably, the electric light has not made that progress which would enable it, in its present condition, to enter into general competition with gas for the ordinary purposes of domestic supply. In large establishments the motors necessary to produce the electric light may be readily provided; but, so far as we have received evidence, no system of central origin and distribution suitable to houses of moderate size has hitherto been established.

In considering how far the Legislature should intervene in the present condition of electric lighting, your Committee would observe, generally, that in a system which is developing with remarkable rapidity, it would be lamentable if there were any legislative restrictions calculated to interfere with that development. Your Committee, however, are not in a position to make recommendations for conditions which may hereafter arise, but at present do not exist, as to the distribution of electric currents for lighting private houses from a central source of power. No legislative powers are required to enable large establishments, such as theatres, halls, or workshops, to generate electricity for their own use.

If corporations and other local authorities have not power under existing statutes to take up streets and lay wires for street lighting and other public uses of the electric light, your Committee think that ample power should be given them for this purpose. There seems to be some conflict of evidence as to whether the existing powers are sufficient or not. But even in regard to local authorities it would be necessary to impose restrictions upon placing the wires too near the telegraph wires used by the Post Office, as the transmitting power of the latter would be injuriously affected

by the too close proximity of the powerful electric currents needed for producing light.

Gas companies, in the opinion of your Committee, have no special claims to be considered as the future distributors of electric light. They possess no monopoly of lighting public streets or private houses beyond that which is given to them by their power of laying pipes in streets. Electric light committed to their care might have a slow development. Besides, though gas companies are likely to benefit by the supply of gas to gas-engines, which are well suited as machines for producing electric light, the general processes of gas manufacture and supply are quite unlike those needed for the production of electricity as a motor or illuminant.

Your Committee, however, do not consider that the time has yet arrived to give general powers to private electric companies to break up the streets, unless by consent of the local authorities. It is, however, desirable that local authorities should have power to give facilities to companies or private individuals to conduct experiments. When the progress of invention brings a demand for facilities to transmit electricity as a source of power and light from a common centre for manufacturing and domestic purposes, then, no doubt, the public must receive compensating advantages for a monopoly of the use of the streets. As the time for this has not arrived, your Committee do not enter into this subject further in detail than to say, that in such a case it might be expedient to give to the municipal authority a preference, during a limited period, to control the distribution and use of the electric light, and, failing their acceptance of such a preference, that any monopoly given to a private company should be restricted to the short period required to remunerate them for the undertaking, with a reversionary right in the municipal authority to purchase the plant and machinery on easy terms. But at the present time your Committee do not consider that any further specific recommendation is necessary than that the local authorities should have full powers to use the electric light for purposes of public illumination, and that the Legislature should show its willingness, when the demand arises, to give all reasonable powers for the full development of electricity as a source of power and light.

Legal Intelligence.

SUPREME COURT OF JUDICATURE—COURT OF APPEAL.

FRIDAY, JUNE 13.

(*Before Lords Justices* BRAMWELL, BRETT, *and* COTTON.)

IN THE MATTER OF AN ARBITRATION BETWEEN JOHN GIFFARD RIDDELL AND THE NEWCASTLE AND GATESHEAD WATER COMPANY.

This was an appeal by Mr. Riddell from the decision of Justices Mellor and Manisty on a special case stated for their opinion by the Arbitrator, Mr. John Clutton, in his award. The arbitration was instituted to settle the amount of compensation to be paid by the Company to Mr. Riddell in respect of land of which he was tenant for life, and which they were authorized to take for the purpose of making the Little Swinburn and Colt Crag reservoirs and other works by the Newcastle and Gateshead Water-Works Acts, 1876 and 1877. The Arbitrator, by his award, determined that the amount to be paid by the Company to Mr. Riddell for the purchase of land, easements, and premises required by them, and for compensation for the damage that might be sustained by him in the execution of the works for which the lands and premises were required, and the exercise of the powers vested in the Company by their Acts, was £17,600, subject to a special case stated by the Arbitrator, which was substantially as follows:—"As part of the compensation for damage which Mr. Riddell would sustain by the execution of the works already mentioned, Mr. Riddell claimed before me a large sum for the water which the Company could collect or divert and impound by the said works; and in the before-mentioned sum of £17,600 I have not included any sum for such claim, it being contended by the Company that I was precluded from so doing by reason of the 7th sub-section of the 9th section of the Act of 1877. But if the Court shall be of opinion that that section is not a bar to the said claim, I award the amount of compensation in respect of such last-mentioned claim to be £5000, which sum I award in addition to the before-mentioned sum of £17,600." The section referred to provided that, for the protection of Mr. Riddell, the Company should be bound to discharge every day not less than 200,000 gallons of water into a stream called the Dryburn, below the site of the Little Swinburn reservoir; and the 7th sub-section of section 9 of their Act of 1877 provided that such water should be taken as full compensation for all water which the Company could collect or divert and impound by the works authorized by the Acts. The Company in their notice to Mr. Riddell to treat for the property to be taken by them gave notice to treat for "water" as well as land. The total amount of land taken by the Company under the two Acts was 1900 acres.

Mr. LITTLER, Q.C., and Mr. WEBSTER, Q.C., for Mr. Riddell, now contended that he was entitled to be paid compensation, not only for the land taken by the Company, but also for the waters lying in and upon, or draining out of the land, irrespective of that flowing in open streams. The land, they said, was peculiarly adapted for the collection of water, and had an enhanced value as a suitable site for a reservoir. That enhanced value had not been taken into consideration by the Arbitrator in the sum of £17,600. The Water-Works Clauses Act, which was incorporated in the private Acts of the Company, required compensation to be given for water as well as land. The sub-section on which the Company relied was only intended to give compensation to Mr. Riddell in respect of the diminution of the water, to which he was entitled as riparian owner of lands lying lower down the streams, flowing from the lands compulsorily taken.

Mr. HERSCHELL, Q.C., Mr. A. L. SMITH, and Mr. EDGE, who appeared for the Company, were not called on.

Lord Justice BRAMWELL said that the case seemed only too plain. The Arbitrator had awarded the £17,600 as compensation in respect of the lands, tenements, rights, easements, and premises required to be purchased, and it was clear that he included in that all rights in respect of water which might accumulate on the land. The Arbitrator then stated that a claim had been made in respect of "the water which the Company could collect or divert and impound" by the works. That referred without doubt to damage which might happen to other lands of Mr. Riddell by the Company intercepting the water which would have flowed to them. If that was the proper construction of the award, it could not be impeached. The counsel for the appellant had attempted to place a different construction on it, but their construction could not be maintained. It was impossible to suppose that an arbitrator, especially one who had had so much experience in such matters as Mr. Clutton, could have made the double mistake, first of omitting to consider any additional value which might attach to the land in consequence of its being a suitable site for a reservoir, and then in concealing the mistake by the language of his award. It did not appear that any injustice had been done, for all matters which might affect the value of the land had been considered. The appeal could not, therefore, be allowed.

Lords Justices BRETT and COTTON delivered judgments to the same effect.

The appeal was consequently dismissed, with costs.

HIGH COURT OF JUSTICE—QUEEN'S BENCH DIVISION.

MONDAY, JUNE 16.

(*Before Justice* MANISTY, *and a Special Jury.*)

WATTS *v.* WEST SURREY WATER COMPANY.

This action, as reported in the JOURNAL for April 16, 1878, p. 598, was originally set down for trial at the Surrey Assizes, Kingston, on the 30th of March last year, but was held over to allow the plaintiff to amend his statement of claim. It is an action in which the plaintiff, who was, in 1876, carrying on business as a brewer at Addlestone, in Surrey, claims damages from the defendants, on account of their having supplied him, during June, July, and August, of 1876, with water which was, as he alleged, not reasonably fit for the purposes of his trade. His case was that the water supplied during May, June, July, and August, of 1876, was so impure, that brew after brew of beer went bad, and was returned by his customers. The agreement between the parties for the supply of the water was of such a nature that the plaintiff might have refused to accept, or the defendants to supply water at any time. It was contended for the defendants that the plaintiff was not entitled to recover, even if the facts were as represented by his witnesses, for, having discovered that the water was impure in May, if he went on using it during June, July, and August, the months for which he claimed, he did so at his peril. The case for the defendants, however, was that the water supplied by them was pure, and witnesses were called who explained the construction and mode of managing the defendants filter-beds; and some brewers were called from the neighbourhood, who stated that during the time complained of they had most successfully brewed with water supplied by the defendants. It was also stated that during the summer months brew after brew would go bad, unless great skill were used, or if the utensils were not kept strictly clean.

Mr. GRANTHAM, Q.C., and Mr. BOXALL now appeared for the plaintiff; Mr. KEMP, Q.C., and Mr. M'MILLAN for the defendants.

The jury, after a lengthened hearing, being unable to agree upon a verdict, were discharged.

Miscellaneous News.

SALE OF CHARTERED GAS COMPANY'S STOCK.

Last Thursday, at the Cannon Street Hotel, there was offered for sale by public auction £100,000 of Ordinary "A" Consolidated Stock of The Gaslight and Coke Company, being the first portion of the additional capital authorized to be raised by the resolutions passed at a general meeting of the Proprietors of the Company, held on the 14th of February last, in pursuance of the powers contained in the Company's Act of 1876. The total amount of stock sold was £64,500, and the price realized was £113,110, being nearly 175⅜ per cent.

The Auctioneers (Messrs. Edwin Fox and Bousfield), in the particulars of sale, stated that the Company—commonly known as the Chartered Gas Company—was established by Royal Charter in the year 1812, and since that date, by the absorption of other Companies, and by extended powers granted under various Acts of Parliament, it has gradually increased, until it has now assumed its present enormous proportions, being the largest gas company in the world. The existing paid-up capital of the Company is as follows:—

Debentures and debenture stocks		£1,529,200
Fixed preferential stocks, viz.:—		
10 per cent. per annum	£665,000	
7½ " "	60,000	
5 " "	30,000	
		755,000
Five per cent. preference shares and stocks, convertible at the option of the holders into ordinary A stock, viz.:—		
Now convertible	£9,850	
Convertible at end of year 1879	500,000	
Convertible at end of year 1880	500,000	
		1,009,850
B stock (4 per cent. maximum, without preference)		100,000
H stock (7 per cent. maximum, without preference)		1,300,000
Ordinary A stock		4,100,150
Total stock and share capital		£7,265,000

In the apportionment of the net profits after payment of the debentur interest and preferential dividends, the relative positions of the ordinary A, B, and H stocks are as follows:—

The ordinary A, B, and H stocks rank *pari passu* up to 4 per cent. per annum (the maximum rate payable on the B stock).

The ordinary A and H stocks then rank *pari passu* from 4 per cent. per annum up to 7 per cent. per annum (the maximum rate payable on the H stock).

The ordinary A stock then takes alone from 7 per cent. per annum up to the standard rate of 10 per cent. per annum.

If in any year the amount of the standard rate of dividend authorized to be paid be increased, under the sliding scale mentioned in the provisions of The Gaslight and Coke Company Act, 1876, then the divisible profits applicable to the payment of such increase may either be appropriated in augmentation of the dividend on the ordinary A stock, or be set apart to the reserve-fund.

The price charged for gas, at the present time, is 3s. 6d. per 1000 feet, and the dividend for the year 1878 was 10½ per cent.

According to the practice hitherto adopted by the Company, the dividend on the stock is calculated half yearly up the 30th of June and the 31st of December in each year, and is payable by warrants on the 1st of September and the 1st of March immediately following.

The districts supplied by The Gaslight and Coke Company, include the City and Westminster, and nearly the whole of London and the suburbs north and north-west of the Thames. The development of buildings in many of these suburbs creates an annual increase in the demand for gas, and with the increase of consumption a saving in the cost of production, with corresponding additional profits, may be looked for.

The capital now offered is required for the extension of the Company's works and plant, to enable them to meet the increased demand for gas above alluded to.

The net profit earned and divided in 1878, after deducting all charges and reserving £20,256, amounted to the large sum of £711,754.

The total amounts now standing to the credit of the insurance and reserve funds respectively are as follows:—

Insurance-fund	£74,259 9 6
Reserve-fund	£147,924 5 0

and the sum brought forward to the credit of the divisible profits for the present year was £101,151 13s.

The prices of the Company's stock during the month of May, 1879, ranged from 177½ to 183 per £100 ordinary A stock.

The following statement shows the quantity of gas sold by the Company

during the last ten years, and demonstrates the increasing character of their operations:—

Year.	Quantity of Gas Sold.
1869	6,448,860,000 cubic feet.
1870	6,763,055,000 ,,
1871	7,528,140,000 ,,
1872	7,545,713,000 ,,
1873	7,922,867,000 ,,
1874	8,286,726,000 ,,
1875	8,938,570,000 ,,
1876	9,472,281,000 ,,
1877	9,934,489,000 ,,
1878	10,635,890,000 ,,

Mr. Fox, prior to the commencement of the biddings, said he had the honour to appear before them that day on a very important matter. It was the first time that any one of the London Gas Companies had submitted new capital for competition, and he thought it would be interesting to those who were not Shareholders of the Company to see the district over which the Company had control. He then referred to a plan showing the Company's district and the relative extent of it as compared with the districts of the other Gas Companies, and said they would observe that the Chartered was the largest Company of the whole. There was no Company to compete with them, and he would call special attention to the fact that one of the advantages connected with holding stock in this Company was that it had a very large territory to develop—a large quantity of uncovered land that would all want gas when it was built upon. The increase of the consumption of gas in this Company was shown distinctly in the particulars of sale, where it would be seen that in 1869 the Company sold 6,448,860,000 cubic feet of gas, while in 1878 they sold 10,635,890,000 cubic feet—almost double, or approximating to that increase. Therefore it must be a very thriving Company, and it was appreciated by the public. The result of their sale of gas in 1878 was that the Company were able, after deducting all charges and reserving £20,256, to divide £711,754 as net profit. The Company, too, had an insurance-fund of £74,259, and a reserve-fund of £147,924. The Company were now under a new order of things. It was formerly thought that gas companies should not be allowed to pay more than 10 per cent., and, as a matter of course, that crippled their efforts, as if they improved the manufacture of the gas, they found that they derived no advantage from it—the shareholders received no more than the 10 per cent. Now, however, under their new Act of Parliament, this Company were allowed to declare a higher dividend than 10 per cent., if they reduced the standard price of their gas, which had been fixed by the Act at 3s. 9d. per 1000 feet. The Company had already anticipated their position by reducing their price to 3s. 6d., and they declared an increased dividend in 1878—namely, 10½ per cent. As, therefore, they improved the supply of gas, the Shareholders received the benefit as well as the public; so the old order of things had passed away, and an improved rule was now in force. Therefore, they were not to stand still at the price that might be quoted that day for the stock of the Company. As a matter of course, there had been great anticipations as to this sale. It appeared that in May last the stock ranged in price from 177½ to 183 per £100 of the A stock; but that day it was quoted at somewhat less than 183. It was for those present to say at what prices he was to sell the stock now offered, but there had been a minimum fixed and sent to the Board of Trade. The dividend which would accrue on the stock now to be offered would run from the 1st of July, 1879, and the first dividend would be paid next year. In reply to a question, he said that there would be no advantage given in the sale to shareholders over non-shareholders. The object of the sale was that inasmuch as the public paid rates for gas it was thought that they ought to compete for any new stock of the Company. That day they would pay no expenses whatever—no stamps, no brokerage, no registration fees. He was now ready to take their biddings on Lot 1—£100 Ordinary "A" Consolidated Stock of The Gaslight and Coke Company, the dividend for which in 1878 was 10½ per cent., and might be materially increased, as no doubt it would.

For lot 1 the opening bidding was 170, on which there were rapidly the following advances:—171, 2, 3, 4, 5, 6, 7, 8, 8¼, 8½, 9, 9¼, 180, at which the lot was knocked down. Lot 2—a similar lot—was taken by the purchaser of lot 1. For the next lot, 175 was the opening bid, and it was sold at 178¼. The other lots offered, in whatever amounts, went generally cheaper, 178¼ never being exceeded, and that price was only obtained once more. For lot 33—£1000 of the stock—174½ per cent. was bid, at which it was bought in. Lots 34 to 36 inclusive realized 175 per cent. For lot 37, 174 per cent. was bid, on which the Auctioneer announced that 175 was the minimum, and the lot was bought in. The rest of the lots purchased went at prices varying from 175 to 177 per cent., and at the close of the sale £35,500 of stock remained undisposed of.

The following are the various prices realized:—

£200	stock sold at	180	per cent.	£360	0	0
800	,,	178¼	,,	1,428	0	0
300	,,	177¾	,,	533	5	0
300	,,	177½	,,	532	10	0
1,600	,,	177	,,	2,832	0	0
800	,,	176¾	,,	1,414	0	0
4,200	,,	176½	,,	7,413	0	0
3,000	,,	176¼	,,	5,287	10	0
1,700	,,	176	,,	2,992	0	0
400	,,	175¾	,,	703	0	0
1,400	,,	175½	,,	2,457	0	0
3,100	,,	175¼	,,	5,432	15	0
46,700	,,	175	,,	81,725	0	0
£64,500				£113,110	0	0

METROPOLIS GAS SUPPLY.

The following is Dr. Whitmore's report on the illuminating power, pressure, and quality of the gas supplied by The Gaslight and Coke Company to the parish of Marylebone during May:—

May.	Illuminating Power in Sperm Candles.			Mean Pressure in Tenths of an Inch.		Mean Quanty. of Sulphur in 100 Cu. Ft.	Mean Quanty. of Ammon. in 100 Cu. Ft.	Sulphuretted Hydrogn
	*Mean of 22 Obser.	Highest.	Lowest.	Highest.	Lowest.	Grains.	Grains.	
Common gas	16·82	17·51	16·30	34·78	16·76	13·03	0·33	No trace
Cannel gas	20·75	22·00	20·21	23·70	13·93	11·23	0·16	No trace

Mean of daily readings of barometer . . . 29·76
,, ,, ,, thermometer . . . 62·99

* Each observation consists of ten readings of the photometer, at intervals of one minute.

The mean illuminating power of the common gas was equal to the light of nearly 17 candles; it ranged between 16·30 and 17·51 candles; showing that on no occasion was it less than about one-third of a candle in excess of the legal standard. On eight occasions it exceeded 17 candles. The mean quantity of sulphur found in 100 cubic feet of this gas was 13 grains, and of ammonia the third of a grain. The mean intensity of light of the cannel gas was equal to 20 candles and three-fourths of a candle; it ranged between 20·21 and 22·00 candles, and therefore was never below the light required by law. The mean quantity of sulphur found in this gas was 11·23 grains, and of ammonia 0·16 of a grain. The pressure of both gases was satisfactory, and on no occasion did the ordinary tests detect the presence of sulphuretted hydrogen.

METROPOLIS WATER SUPPLY.

Conference of Vestry Delegates in St. Martin's-in-the-Fields.

Last Friday the Delegates from the Vestries and District Boards of the Metropolis held another meeting at the St. Martin's Vestry Hall—Mr. E. J. Watherston in the chair—with reference to the question of the water supply of the Metropolis. The following resolution was carried *nem. con.*:—"That a new memorial be addressed to the Home Secretary, setting forth the evils of the present system of supply, but referring mainly to the question of finance raised by Mr. Cross; that he be asked again to receive a deputation that that point may be fully discussed, and a financial plan developed; that a copy be sent to him one week in advance, for consideration, and in order that he may have the opportunity of consulting with his colleagues whether they will or will not deal with a home question of so deep an interest to the people of London."

The Registrar-General publishes the following table of the average daily quantity of water supplied to London during May, 1879. According to the returns furnished to him by the Metropolitan Water Companies, 132,584,518 gallons, or 602,392 cubic mètres of water (equal to about as many *tuns* by measure, *tons* by weight) were supplied daily; or 236·6 gallons (107·5 decalitres), rather more than a *ton* by weight, to each house, and 33·3 gallons (15·1 decalitres) to each person, against 32·5 gallons in May, 1878.

Companies.	Number of Houses, &c., supplied in May, 1878.	Number of Houses, &c., supplied in May, 1879.	Aver. Daily Supply of Water in Gallons* during May, 1878.	Aver. Daily Supply of Water in Gallons* during May, 1879.
Total supply	544,217	560,466	125,453,161	132,584,518
From Thames	257,295	265,860	62,788,068	68,303,106
,, Lea and other Sources	286,922	294,606	62,665,093	64,281,412
Thames.				
Chelsea	29,014	29,700	8,728,200	8,480,200
West Middlesex	50,677	52,145	10,187,794	10,752,634
Southwark and Vauxhall	80,431	83,263	18,350,000	23,910,463
Grand Junction	38,462	39,648	12,333,974	12,101,909
Lambeth	58,711	61,104	13,188,100	13,057,900
Lea and other Sources.				
New River	126,629	128,099	28,305,000	27,065,000
East London	115,143	118,910	26,400,000	29,136,000
Kent	45,150	47,597	7,960,093	8,080,412

* Including that for manufactures and for various purposes other than for domestic consumption.

Note.—The return for May, 1879, as compared with that for the corresponding month of 1878, shows an increase of 16,249 houses, and of 7,131,357 gallons of water supplied daily.

The following is Dr. Frankland's report on his analyses of the Metropolitan Water Supply during May, 1879:—

"Taking the average amount of organic impurity contained in a given volume of the Kent Company's water during the nine years ending Dec., 1876, as unity, the proportional amount contained in an equal volume of water supplied by each of the Metropolitan Water Companies, and by the Tottenham Local Board of Health, was—Colne Valley, 1·4; Kent, 1·7; Tottenham, 1·8; New River, 2·9; East London, 2·9; Grand Junction, 4·0; Lambeth, 4·2; Southwark, 4·4; West Middlesex, 4·6; Chelsea, 4·7. The Thames water delivered by the Chelsea, West Middlesex, Southwark, Grand Junction, and Lambeth Companies has again suffered from floods. It contained a large quantity of organic matter, even after efficient filtration, to which it had been subjected by all the Companies. The Lea water distributed by the New River and East London Companies had also been efficiently filtered before delivery, and it was of much better quality than that abstracted from the Thames. The deep-well water delivered by the Kent and Colne Valley Companies and by the Tottenham Local Board of Health was clear and of its usual excellent quality for dietetic purposes. Seen through a stratum 2 feet deep, the water presented the following appearances:—Kent, Colne Valley, and Tottenham, clear and colourless; Chelsea, West Middlesex, Southwark, Grand Junction, Lambeth, New River, and East London, clear and pale yellow."

Results of Analyses expressed in Parts per 100,000.

Companies or Local Authorities.	Total Solid Matters.	Organic Carbon.	Organic Nitrogen.	Ammonia.	Nitrogen, as Nitrates and Nitrites.	Total combined Nitrogen.	Chlorine.	Total Hardness.
Inner Circle.								
Thames—								
Chelsea	28·16	·242	·038	0	·252	·290	1·5	21·5
West Middlesex	30·72	·235	·038	0	·218	·256	1·6	22·1
Southwark	29·20	·237	·024	0	·216	·240	1·5	21·8
Grand Junction	30·16	·199	·040	0	·218	·258	1·5	20·8
Lambeth	31·66	·212	·036	0	·247	·283	1·6	23·3
Lea—								
New River	28·34	·149	·026	0	·253	·279	1·5	22·1
East London	28·54	·142	·032	0	·205	·237	1·6	21·3
Deep wells—Kent	41·60	·087	·018	0	·466	·484	2·5	30·6
Outer Circle.								
Colne Valley	13·02	·063	·018	0	·322	·340	1·5	6·60
Tottenham Local Board	41·00	·087	·022	·045	·025	·184	2·7	23·5
Corporation of Birmingham*	25·00	·113	·022	·005	·209	·235	1·9	14·0
Corporation of Glasgow†	3·00	·130	·016	0	·008	·024	0·60	1·11

* Analyzed by Dr. Alfred Hill, Medical Officer of Health and Analyst to the Borough.
† Analyzed by Dr. E. J. Mills, F.R.S., of Anderson's College, Glasgow.

Note.—The numbers in the analytical table can be converted into grains per imperial gallon by multiplying them by seven, and then moving the decimal point one place to the left. The same operation transforms the hardness in the table into degrees of hardness on Clark's scale.

The following is Dr. Whitmore's report on the composition of the water supplied to Marylebone during May:—

May.	In Grains, per Gallon.							In Parts, per Million.		In Degrees.	
	Total Solid Matter.	Loss by Incineration.*	Chlorine.	Equal to Chloride of Sodium	Nitrogen as Nitrates and Nitrites.	Oxygen required for Oxidizable Matter.	Estimated Organic Matter.	Free Ammonia.	Albumenoid Ammonia.	Hardness.	Hardness after Boiling Fifteen Minutes.
West Middlesex	22·40	0·92	1·22	2·01	·102	·046	·368	·018	·082	15·1	4·7
Grand Junction	21·40	0·88	1·24	2·04	·101	·046	·368	·010	·084	14·4	4·7
River Thames at Hampton	21·20	1·40	1·30	2·17	·119	·090	·720	·03	·15	14·3	4·7

* The loss by incineration represents the amount of organic and other volatile matters contained in the Imperial gallon (70,000 grains) of water. The total solid matter, *minus* such loss, consisted chiefly of carbonate of lime, with small quantities of other equally harmless salts.

Temperature of West Middlesex water taken from main on 13th inst. 50° F.
Temperature of water taken from Thames at Hampton on 10th inst. 49·5° F.

The water as drawn from the mains of both Companies, when examined through a tube 2 feet in length, showing a stratum of water to that extent, was clear and bright; that taken from the River Thames was slightly turbid.

BRITISH ASSOCIATION OF GAS MANAGERS.

(*Continued from page* 936.)

TUESDAY, JUNE 10.

We shall now proceed to publish the papers presented to the meeting, with the discussions thereon, in the order in which they were taken.

Mr. W. COWAN (Edinburgh) read a paper on

THE AUTOMATIC PRESSURE CHANGER.

[A specimen of the apparatus was exhibited in action during the meeting; and, on page 990 of the present issue, we give an illustration and full description of the working of the Changer.]

This is an apparatus for automatically varying the load and pressure of gas governors, the loading material being water or other liquid.

The growing difficulty in obtaining the services of persons who may be thoroughly depended upon to perform important duties, however simple, has produced a general demand for self-acting apparatus.

I have thought the changing of gas pressure to be, in theory, as much within the sphere of automatic action as the maintaining of it has hitherto been in practice. The practical application of the theory will be found in the machine before you, which is the subject of this paper.

The loading of governors with water, though not unusual, is by no means common. For a man to open a water-tap, and then, before closing it, to have to wait the accumulation or reduction of the load required to raise or lower the pressure to any given point, has to most persons appeared an unjustifiable loss of time, when it is considered that a metal weight instantly put on or taken off answers the purpose sufficiently well. And the same operations having to be repeated each time the pressure has to be changed, it need not be surprising that the more speedy, though rougher mode should have been more generally adopted, and the not unimportant advantages of water loading disregarded. Yet, in many large gas-works, the latter system is practised, and its superiority admitted; as with it not only is the pressure more gradually altered, but all risk of disturbance to the governor while loading is avoided.

Its advantages in reducing the pressure, however, have not hitherto been so clear; because, to effect this, a tap or valve in mechanical (even though flexible) connection with the bell has had to be opened, and there has been almost as much danger of disturbance through operating such tap or valve as in removing weights. "The Automatic Pressure Changer," in addition to its other advantages, entirely removes this difficulty, by withdrawing the water through a syphon, which is not in contact with the governor bell.

The functions of the instrument are—

> To open a tap for the supply of water to load the governor to any required pressure; to close the tap when such pressure is reached; and to repeat the same operations for the attainment of still higher pressures at such times, and to such degrees as may be necessary. In like manner to open another tap for the withdrawal of water to unload the governor when a lower pressure is desired; to close the tap when such pressure is reached; and to repeat the same operations for the still further reduction of the pressure as often, and to such extent as required.

The number of changes of pressure the instrument can effect is not only equal to, and even beyond all practical requirements, but it admits of all necessary variation of the order in which they may be produced. It may be arranged to go on increasing (more or less gradually) from the lowest to the highest desired point, and then, after any required interval, to reduce the pressure to the minimum. Or it will make pauses of any desired duration at particular pressures (both while increasing and decreasing), and resume again, at the end of each pause, till the maximum or minimum, as the case may be, is reached. Or it will first raise the pressure to the required degree, and then, after the desired pause, lower it; then raise it again; and so go on increasing, reducing, or pausing, according to the requirements of the locality in which the governor it controls is placed.

Having given a general account of the functions of the Changer, I may, perhaps, be excused from entering upon any minute description of the machine itself. You will, I hope, obtain by observation of the apparatus here at work, not only a more interesting and enduring impression of its probable usefulness, but also a fuller understanding of its details, than it would be possible for me to give here. The principle will be readily understood, though the particulars of the construction do not admit of very easy or brief description. With such dry details I do not desire to occupy your time. I would briefly say, that the clock determines the time, and the gasholder weights the degree of the loading and unloading of the governor by the Changer. To alter the position of a tappet, on the clock disc, is to change the time at which it will act to raise or lower the pressure. To increase or decrease the weights on the gasholder basket is to vary the degree to which the pressure will be raised or lowered.

It is the union of the clock and pressure, as motive powers, which renders this machine thoroughly automatic. But besides these, there is a third motive power employed, which is not only of essential importance for the accurate working of the taps, but which also serves the useful purpose of lessening the demand upon the other two. I refer to the weighted pulleys, to the axis of which each tap is fixed. The clock does not itself open, nor does the pressure itself shut the taps. The clock merely releases the levers, which then permit the weighted pulleys to rotate the taps into the open position. The pressure (acting through the gasholder) only releases the levers, which then allow the same pulleys to move the taps into the closed position. The power to turn the taps is in the weighted pulleys, which are wound up weekly along with the clock. The clock employed has a weight, not a spring, for its motive power.

The effect of the pressure on the gasholder is restrained by a series of weights, taken up and deposited successively, at various points of the bell's ascent and descent. These points approximate to those at which the tappets on the gasholder disc act upon the levers. Hence the lifting or losing of a weight is nearly coincident with the closing of a tap when the pressure that the weight balances is attained. The tappets on the clock disc may be two or more. If the machine is required simply to raise or lower the pressure gradually between two points, only two are required. But if pauses at particular pressures are necessary, an extra tappet for each is required. The arrangement of the clock disc makes a variation of the number of tappets in action quite easy. They may, with great facility, be placed so as to be in or out of contact while passing the levers, or varied in their times of acting upon them.

The number of tappets in action on the gasholder disc must correspond with that of those on the clock disc. Any of them may be placed so as to be out of contact in passing the levers, when the number would exceed that of those set for action on the clock disc.

For a machine of this kind to be perfectly satisfactory, it has appeared to me necessary, that while doing its own work, it should not interfere with this being occasionally done by other means—on the occurrence, for instance, of dark or foggy weather. At such times, pressure might have to be put on at hours, and to degrees, for which the tappets had not been set, and it might not be desired to disturb the arrangement. This contingency has been provided for by constructing the taps with gas or air, as well as water passages, which open and close simultaneously. The pressure-pipe from the governor is led close to the taps, and there divided into two branches, one being connected to each. These branches (beyond the taps) are re-united into one pipe, which is led to the gasholder. When either tap is open to supply or withdraw water, gas or air is then free to pass to or from the gasholder; but when the water passages are closed, so also are those for gas or air, and the machine is thus shut off from its connection with the governor, till the time for the next change of pressure arrives. Loading or unloading by other means is therefore not only possible, but easy, and productive of no derangement. For these purposes each tap is provided with a bye-pass and tap, which may be opened and closed by hand.

I have desired that this latest addition to the number of automatic gas appliances should be equal to every probable requirement, and as free as possible from objections in practical use. If, with this object, I have included some provisions which may not appear necessary in every case, one or more of them (as experience may suggest) may be dispensed with. For example, if the quantity of water to be transferred be large, or, if small, be slowly passed, and therefore the time so occupied greater than that during which the clock disc tappets hold the levers out of catch, the supplementary levers and catches are then unnecessary. No undue running down of the pulleys being probable, the provision against it may be omitted.

In like manner, when the change is continuous, and therefore only two tappets are employed, the gasholder disc may be dispensed with, and the tappets attached directly to the vertical rod of the bell. For, although the disc is of service in making the tappets act in a circle, and therefore more freely disengage themselves from the levers, it is chiefly useful because it admits of placing a number of tappets in a small space.

In some instances, little importance may be attached to the provision for loading and unloading independently of the instrument. For such cases, the taps need not have gas or air passages, but be constructed for water only—an arrangement admitting of greater simplicity in the stand, as well as in the taps and pipes to which they are connected.

In indicating how the apparatus might be presented in a more simple form, I am yet of opinion, that the one in which it is here shown is likely to be the most generally useful, and suitable in the greatest number of cases.

I think it not impossible that, instead of your seeking any modification of the machine in the direction of simplicity, you may rather be disposed to take full advantage of the facility it offers for introducing some improvements in the arrangements of the pressures themselves.

I have referred to the pressure passages, as for gas or air. When used with the "Foulis" governor, for example, the gasholder may be actuated by the air pressure, instead of the gas from the main.

The possibility of dispensing with a pressure register, where the effects it is employed to record are produced automatically, has occurred to my mind. The utility of the register as a check upon a man is undoubted. Its value as a check upon the performances of this machine would depend upon its necessity; and this, experience will determine. In the meantime, a pressure register may be combined with the Changer, and actuated by the same clock.

Discussion.

The PRESIDENT said that a considerable amount of ingenuity had been expended upon the instrument exhibited. He admired the beautiful syphon arrangement in the bell, to which he would draw attention, as it was hidden by the holder. One of the pipes or leg of the syphon dipped down into a sealed tube, so that without any friction whatever the water could be withdrawn, and the pressure adjusted. This was important in any such instrument. As managers often felt they were not quite safe in leaving the regulation of the pressure in the hands of all foremen, such an instrument as this would be of great service.

Mr. W. H. BROADBERRY (Tottenham) said there could not be two opinions as to the desirability of some automatic arrangement for increasing the pressure, but this was so new a one that it was impossible to discuss it fully at present.

Mr. CORBET WOODALL (London) said that he had had an opportunity of using one of Mr. Cowan's Automatic Pressure Changers for two or three months. When the apparatus was first delivered to him he regarded it with a considerable amount of alarm, for its appearance conveyed the idea of great complication and elaborate apparatus, requiring to be maintained in efficient working order, because the failure of any one portion would, unquestionably, mean the failure of the whole operation; and the fixing of an automatic apparatus would be simple folly, unless it could really be trusted to do its work without being watched. Immediately on the Changer being fixed, one difficulty presented itself. Mr. Cowan had referred to meeting certain contingencies, and it seemed to him that every contingency which had arisen had been met, and with the same intelligence and ingenuity which the whole apparatus displayed. The difficulty he found was this—that, when first fixed, the pressure was regulated by the pressure in the gas-mains. Now at the particular place where the Changer was fixed the pressures were controlled from two different distributing stations, and were not always put on with perfect regularity; consequently, while there was 2 inches of pressure at one, at the other there might be 2½ inches. Thus the machine was thrown out of action, and there would be some risk of the pressure having gone down altogether from the syphoning out of the whole of the water, or too much pressure

being put on. This difficulty was immediately met by Mr. Cowan. He removed the motive force from the street-mains to the pipe connecting the gasholder with the bell of the governor itself. In this case it was a Foulis governor, so that they could deal with the inside of the bell. In that way, the alteration of the pressure being determined by the weights on the small governor, when the water was turned in to the tap of the governor it was lifted altogether independent of the pressure in the street-mains. He (Mr. Woodall) could not presume to explain the details of the apparatus, but he might say that its action had been absolutely perfect during the short time he had had it in use. Of course, he could not say to a body of practical men that any one, on the strength of three months trial, would venture to say it was altogether a success. In reference to such a matter, even after twelve months, there might possibly be some little hesitation, because the failure of one day would practically condemn the success of twelve months; but the apparatus seemed to be made so perfectly, the whole of the work about the cocks and tappets being done with so much exactitude, that it did seem to him probable that it would go on working in the same satisfactory manner for an unlimited time. In putting on pressure, the usual interval between the highest and the lowest pressure would be covered by about one hour, and therefore, instead of increasing the number of tappets, whereby 2-10ths could be put on every five minutes, or any other interval chosen, he should prefer to put one tappet just to open the communication, and leave the tap supplying the water to the bell so placed that, in three-quarters of an hour or an hour, the exact quantity would go through to increase the pressure to from 2 to 2½ inches, or whatever pressure was required. The tap being once opened, a stream of water would continue to flow through, and at the end of a certain time the requisite pressure would be on, and the tap shut off. So it would go on until the required time for reducing it, when it would be again opened, and the whole of the pressure taken off in the same gradual way. He congratulated Mr. Cowan on the extreme beauty of the apparatus, and wished it every success.

Mr. Cowan then explained the apparatus exhibited, stating that there was no governor in connection with the Changer before the meeting, because there was nothing to govern, the day pressure of gas in the hall not being sufficient. The gasholders loaded and unloaded by the machine were simply a means of obtaining pressure to act responsively on the Changer and show the action. Had the gas pressure in the hall been 3 or 4 inches, a governor in full action might have been shown.

Mr. H. Peaty (Longport) asked the length of time required to go from the lowest pressure to the highest. He said that in his works he had a water-tap over the top of the governor, which was surrounded for about six inches in depth by a small tank. After one or two attempts, it could be told by the dripping of the tap how much would turn the disc, and a little tap placed at the top would, when the time arrived to release the pressure, be turned off; while another little tap at the bottom being turned on would reduce the pressure in about half an hour's time. By having two taps so arranged, it appeared to him that he obtained all the advantages derived from this instrument.

Mr. W. Carr (Halifax) said he had had the pleasure of seeing in Manchester one of these instruments at work—the one, he believed, which had been sent to Mr. Woodall. He did not think Mr. Cowan had done justice to his own invention, for it was not nearly so complicated as would appear, either from the first view of the machine itself, or from Mr. Cowan's description. When he (Mr. Carr) first saw it at Manchester, his feeling was that it was very complicated, and he felt almost afraid to touch it himself, much less trust any one else to have anything to do with it; but when he began to see it at work, that feeling rapidly passed away, and he saw that, although the parts were apparently numerous, they were not separate and distinct parts, but simply parts working in conjunction with each other. For instance, there were two levers actuating the same cam, one being simply a check on the other; and the way in which the two levers worked was one of the most beautiful mechanical arrangements he had seen for the opening and shutting of a tap. It was altogether different from a man going twice a day and shutting or opening a tap, as Mr. Peaty suggested, and he believed Mr. Peaty would himself be convinced of this when he properly understood the nature of the machine. As far as he could see, the Changer was absolutely reliable. The only thing required was the winding up of the clock; and if that continued to work, and the string of the weights did not break, he could not see any possibility of the apparatus getting out of order.

Mr. C. Hunt (Birmingham) said the instrument before them appeared to be highly ingenious, and they were all glad to have Mr. Woodall's testimony as to its practical worth. There appeared to him, however, to be one objection to the application of any automatic arrangement for governing pressures, which had already been referred to, although not dwelt upon to the extent that seemed to him desirable. They all knew that they had to alter the times of putting on pressures, as the summer advanced or receded, with a regularity that might be called constant; but there were times when this had to be altered in consequence of dark weather, which called for continual watchfulness on the part of the man in charge, who, if relieved ordinarily of the duty of putting on the pressures, might very possibly, through forgetfulness, act as though he were absolved from doing it when required from accidental circumstances such as those he had mentioned, and so the public might be left to wait until the neglect had been repaired, or the Automatic Changer chose to perform its office.

Mr. Sugg (London) said when he first saw the apparatus it struck him, as it did Mr. Woodall, as being slightly complicated; but the complication was more in appearance than in reality. He had had, many years ago, considerable experience at the South Metropolitan Gas-Works in regard to putting on and taking off pressures. Mr. Peaty said that this apparatus was doing much the same kind of thing as he had accomplished by the aid of taps. Every one knew the usual plan of putting pressure on by means of water—having a cock regulated to drip so as to take a certain time to put the pressure on, and then turned again to let the water run off. The only thing required in the arrangement was that the man should be on the spot at the proper time to put on the pressure, and again at the proper time to take it off, and if he was not there the pressure did not get either put on or taken off. By this arrangement, if it was desired to begin putting the pressure on at six o'clock, and go on increasing until seven or eight, and then to begin about nine o'clock to take it off, this could be easily regulated by the little tappets, which could be so arranged as to increase the pressure by 1-10th at a time, or do so all at once. With regard to taking the pressure off, if the man did not come to his time the pressure remained, and that would just correspond to the breaking of a string in this apparatus—it would put the weight on. But in all works there would be the possibility of seeing the pressure-gauge, so that the damage would at once be discovered and put right. As to the point referred to by Mr. Hunt, of a sudden demand arising, they knew this would occur sometimes; for he had found that, for example, in the Greenwich district, if a dark cloud passed over the town, the pressure had to be increased. Of course no automatic changer would do this, but it could be attended to separately.

Mr. F. W. Hartley (London) said the application of water to communicate pressure to a governor was a very old thing, and had been applied in a vast number of ways. In the discussion it had been assumed that it was necessary for a man to go and turn the water off, as well as on. As a matter of fact, the latter necessity had been effectually obviated by a very ingenious contrivance by Mr. Price, of Hampton Court. He had the water running in at the top of the bell, and when it reached a certain point within the vessel containing it, a syphon came into operation, and the water was gradually and slowly drawn off as he chose to regulate. By this means he obtained a steady admission of water into the vessel giving a pressure, and an equally steady abstraction reducing it; while he had it in his power, in the one case or the other, to put it on rapidly or take it off quickly. But there was a difference between that instrument and this. This one was meant to go for a week, and was an instrument to be placed in the hands of the master rather than in those of the man. So far it was a step in the right direction. It involved very little trouble, simply winding the clock up once a week. A manager could not go and see that his man applied the pressure every day, but he could check the man's work by using a pressure register. The apparatus certainly did look a little complicated, but still he recognized that it was not so after the explanation which had been given, and he must express his admiration for what appeared to him to be a very admirable instrument.

Mr. Woodall said he had not had any experience of the difficulty mentioned by Mr. Hunt, because the apparatus was placed in a governor-house, and constantly watched over by a man; therefore any change such as had been named would be made immediately by putting on pressure in the ordinary manner. As far as he could see, there was no possible way of meeting such a contingency other than by the intelligent operation of a man himself. He was sure Mr. Peaty would see in a moment, on looking into the apparatus, a vast difference between it and what he referred to. They all knew what a tendency there was in a tap nearly turned off to stop altogether, and a man going every night at a certain hour to turn a tap was a very different thing to an automatic arrangement. If this were placed at a distance from the works, as many governors were, the advantage was more perceptible than when it was placed at the works themselves.

Mr. Cowan, in reply, said: The gentlemen who have spoken have done so in such favourable terms that there really remains little for me to say. No objections of importance having been urged, there is nothing calling for any reply from me. There is, however, one point I desire to refer to. One gentleman said that although I had provided for loading and unloading, independently of the Changer, during dark or foggy weather, it might happen that on such occasions there would be no one at hand ready to perform the duty, the machine having superseded the man who, under the present system, would perform it. If this appears a difficulty to any one, I may say that when I recently saw Mr. Hepworth in Edinburgh, I described to him my plan for operating the Changer from a distance by electro-magnetism. He agreed with me, however, that it would not be desirable to introduce such a proposal here, lest it might be thought that batteries, wires, and electro-magnets were necessary for the ordinary working of the Changer. I had, therefore, resolved not to say anything on that subject. As some prominence has been given to the foggy weather argument, I would say that if you are prepared to lay the necessary wires, you may have the clock and disc in the gas office, or other convenient place, whilst the rest of the machine is beside the governor. A couple of electro-magnets to act upon the levers which open the taps, would have the same effect as the clock disc has when acting upon them directly. The disc at a distance would complete the electric circuits, and cause the magnets to attract the levers out of catch, and so open the taps. Then, to make sure of the proper result being attained, the gasholder in rising and falling would complete other electric circuits, which, acting upon magnets in the gas office or elsewhere, would produce an indication that the pressure proper to the hour was established. I have devised for this purpose an indicator of very simple construction, consisting of a weighted catch pulley and levers, which requires no continuance of the closed circuit, and, therefore, causes little waste of battery power.

The President said he thought they were now fairly acquainted with the construction and working of the machine. It was certainly very desirable to take steps in the direction of automatic regulation of pressures. Nothing yet had been put forward that could so thoroughly adjust them as this instrument. The Association was indebted to Mr. Cowan for his paper, and the exhibition of his very ingenious and beautiful machine.

Mr. T. Travers (Cork) read a paper entitled,

HOW CAN GAS COMPANIES BEST PROMOTE THE APPLICATION OF GAS FOR HEATING PURPOSES?

In the following remarks on the subject of gas for heating purposes, I by no means pretend to offer a paper in the usual sense of the word; I am simply anxious that a question of such growing importance should not be omitted from the programme of the proceedings. If any other member had been prepared to "open the ball" by starting the discussion, I should not be found this year again claiming your indulgence. After briefly stating the case, like a junior counsel, I will leave the question in its more elaborate and intricate form to be dealt with by my more able colleagues.

This is comparatively a new branch of our industry and we have yet much to learn, so every day's experience is really important to us. In order to gain this experience, gas companies must be prepared to pay for it in one shape or another. The proceedings of many gas companies during the past twelve months is encouraging in this respect, inasmuch as, by the promotion of exhibitions, &c., they have shown an off-hand, liberal, and businesslike spirit, thus giving ample evidence of the convenience and excellence of gas as fuel. The public, therefore, should by this time be thoroughly educated to the fact that their prejudices were utterly groundless which in times past retarded this very important application of gas.

While speaking on this point, I will venture to occupy a few moments in giving an illustration. A gentleman in Cork, of undoubted scientific attainments, and the author of some valuable inventions, received a suggestion from his wife as to the desirability of using gas for cooking purposes. He pooh-poohed the idea, and could not be induced to believe that meat cooked by gas would be eatable. Taking advantage of her husband's absence from home, the lady arranged with me to fix a gas range without his knowledge. On the day of his return, dinner was served as usual, and almost the first remark he made was, "You have changed your cook. I never before found the meat so well flavoured." He was greatly surprised when told that there had been no change in the cook, but the actual change was in the fuel, and the improvement he noticed was due to the use of gas. The next day he ordered all his cooking arrangements to be altered for gas fuel. But this is not all. A fortnight afterwards, while we were enlarging his supply-pipe to meet the increased demand, the gas apparatus had to be disconnected, and the cook was obliged to return to the old system for that day. In the evening there was consternation in the dining-room. The master declared that the cook had poisoned the meat with gas, and that he knew such would be the case. An explanation was demanded from the cook, and certainly he "set the table in a roar" when he informed the master that no gas

whatever had been used that day. This gentleman is now paying about £60 a year for gas for cooking purposes.

Although a good deal has been done in the way of exhibitions—awarding prizes to good makers, and supplying stoves on easy terms—yet gas companies must be willing to go beyond this, otherwise their previous efforts will prove to have been futile. We must assist the consumer in the economical consumption of gas, and thus indirectly reduce its price, for it must be admitted that the cheapest gas at present is an expensive fuel, unless used with care and economy.

I know there are makers who will guarantee their stoves to perform a certain amount of work with a certain quantity of gas, and thus far gas fuel will appear to be cheaper than coal. I have tested such stoves, and found them to be, on the whole, very nearly up to the representation, and in good faith I have supplied them to the consumers, with the assurance that they would find them, with regard to the consumption of gas, as cheap as coal; but at the end of the quarter the consumer is startled by finding his gas bill increased enormously, and far beyond what he had been led to expect. Moreover, his coal merchant's bill is not reduced one shilling. It is useless, then, to talk of the superiority of the cooking, and the convenience and cleanliness of the fuel. You are at once met by the £ *s. d.* argument, and with an order to remove the stove. Perhaps your own character is not improved by the transaction; thus you have lost a customer, and you are victimized by the carelessness and neglect of others.

All who have had experience in this matter will testify to the fact that this is over and over again the case. I firmly believe that by gas companies taking such steps as will assist the consumers to prevent this waste, they will more effectually develop the use of gas for heating purposes than by many other means. It is my conviction that if we make gas fuel as cheap as coal, our case is proved.

From two causes does this waste arise—

1. When the stove is fixed, it is generally connected with the ordinary fittings of the house, and supplied through the existing meter, or in some cases the meter is enlarged; therefore, in order to supply the stove, you must have gas turned on all day throughout the entire premises, subject to leakage, condensation, &c., for a much longer period than would be required for lighting purposes.
2. The careless, unchecked, and almost unlimited use of gas inevitably leads to a very unnecessary consumption. In many cases servants who have charge of this department feel that they have no responsibility with regard to cost.

One fact will illustrate this latter point. Last year we fixed a stove in a large establishment, the Company, at considerable expense, arranging for the erection of it. When the stove was put in operation, the consumption of gas was increased by 13,000 feet per week; in other words, the cost of the gas appeared to be three times the cost of the coal for the same amount of work. We made several observations, and saw clearly that no such quantity was necessary; but it was almost in vain that we pointed out this fact to the authorities. The cooking was acknowledged to be good, and labour was saved; but the cost of the gas was enormous, and unless we were prepared to reduce the price to about 1s. per 1000, the stove was doomed to extinction. At length an arrangement was arrived at to enable us to lay a separate supply, and fix a separate meter. An official of the Company attended for one week, and that week's consumption was reduced to 5400 feet. Since that time the stove has been regularly at work. The consumption of gas is deemed satisfactory, and the cook is now aware that the meter is actually a monitor to keep extravagance in check. More than that, I have a testimonial in writing from the head of the establishment, to say that there is as much coal saved as is represented by the quantity of gas used; therefore "Old King Coal" was turned out by his offspring.

With such cases before us, and remembering the fact that gas supplied during the day is a source of additional profit to gas companies, I say it is their duty to promote this object, although at additional expense and trouble.

I would look on the introduction of a stove to a house as a new consumer, and treat the case accordingly. In the first place, I would give the stove a special supply; secondly, I would use for it a separate meter; thirdly, I would have the index of the meter taken every month, and advise the consumer, having previously furnished him with an approximate estimate of the amount of work the stove was capable of performing with a certain quantity of gas.

If it were necessary to prove the advantage to be gained by such an arrangement, I should be able to do so by several well-ascertained statistics, which would show, where the opportunity was afforded for the supervision referred to, the results were satisfactory, and in many cases so much so that additional accommodation was asked for. On the other hand, where the stoves were left to take care of themselves, they were regarded as an expensive luxury, treated accordingly, seldom made use of, and, in too many instances, dispensed with after a short trial.

Notwithstanding the care and economy which would be secured by the above suggestions, there are many cases in which the price of gas would not admit of a favourable comparison with the cost of other fuel. When the price of coal is taken at the average rate, and gas at over 4s. per 1000, the margin becomes very narrow indeed, and yet it is decidedly to the advantage of all gas companies that gas for heating purposes should be developed, inasmuch as it would lead to a good day consumption, thereby rendering a large portion of capital doubly productive. With this view I think it would be the duty of companies to provide every facility for the consumer.

Under this head, Mr. Denny Lane, whose attainments are well known in the scientific world, has requested me to call your attention to the following important facts, ascertained from experiments made recently on the heat communicated to water in various boiling-stoves. If we count as a thermal unit the quantity of heat necessary to raise 1 lb. of water 1° Fahr., the number of thermal units communicated to the water in no case exceeds 450° per cubic foot of gas, whereas more than 30 years ago Mr. Defries stated that, in an apparatus for heating a bath, he had communicated 750 thermal units for each cubic foot of gas consumed. In some cases it has been alleged lately that nearly double this amount had been attained. It seems impossible, unless the chemical composition of the gas were totally different from that calculated by Mr. Vernon Harcourt from the calorific efficiency he analyzed. He fixed the maximum for ordinary gas at 750 thermal units. Mr. Lane, therefore, strongly recommends that a series of experiments should be commenced by some independent authority, to ascertain what kind of apparatus yields the most economic results. In recording these experiments, the illuminating power should always, and the chemical composition where possible, be carefully noted.

Another point is this. While it is wise to supply stoves on easy terms, yet I must say, speaking from experience, that the three years system of purchase would prove more satisfactory to gas companies and their consumers than the hiring system, in which case the stove continues to be the property of the company. Under this latter system, I have found that the consumers are careless about the stoves, subjecting them to treatment they would not permit were they their own property.

In conclusion, it is with reluctance that I appear before you a second time on the same question; but I trust the ideas I have put forward, however crude, on this important subject, will induce others to elucidate more fully its various interesting points.

Discussion.

Mr. W. Barratt (Grantham) said gas managers and companies had had serious difficulties to pass through, but if they could do as Mr. Travers had done, and get the ladies on their side, they would go on and nothing could stop them. He had paid considerable attention to gas-stoves, and thought the best way was to begin in his own house; and consequently he had a gas-stove fixed in his kitchen. Unfortunately (or fortunately) it did not answer, and the reason he found was this—and perhaps in 99 cases out of 100 it was the same—that the supply-pipe was not sufficiently large. He found that when the servants were about to prepare for dinner, they invariably lit the stove half an hour before it was required, and, as a matter of course, there was a large quantity of gas wasted. He at once altered this state of things, and since then he had fixed a large number of gas-stoves in Grantham. He always suggested an enlarged supply-pipe, and where that was done he never knew gas-heated stoves to fail. If there was not a good supply-pipe to the oven the gas came through in a sluggish way, gave but little heat, the cook got into a bad humour, and the whole thing was discredited. He was satisfied that there should be a separate supply, and a separate meter, so that the gas might be turned off for the whole of the house without affecting the heating apparatus, and when that had been done he invariably found it answer. His rule was to put in a ¾-inch service-pipe, and he thought this would be a great source of revenue to gas companies in time, if they only paid attention to it. Rather than allow individuals to be dissatisfied, he would put in an additional service at the cost of the Company, and he thought they would be gainers by it.

Mr. W. Wright (late of Brighton) said that there could be but one opinion as to the very practical character of the paper they had listened to. A separate service with a separate meter commended itself to his judgment especially, and he thought also the gas-cooking arrangements of the house should be under the supervision of the manager of the gas-works. Not that he wished him to be the cook, but that the index of the gas-stove meter should be taken separately, and at frequent intervals, with an occasional inspection of stove burners. He had pushed this matter in works of which he had had the charge, and with some success. He would mention another matter which came under his notice, as one of the causes which tended to bring gas cooking into ill odour with consumers. A gas-cooking arrangement was put into a gentleman's house and went on for some time satisfactorily, but when the gas bill was sent in he was alarmed at the amount, and he (Mr. Wright) himself could not understand it, the register being largely in excess of anything he had expected. The gentleman paid the bill under protest, and some time after it came out incidentally that the cook, having gone to turn the gas on at the stove, found it had been left on since it was last used, so that really the gas had been burning for several days without anything being done by it, which, of course, accounted for the extra consumption.

Mr. E. Goddard (Ipswich) said he had had some experience in the application of gas for cooking and various domestic and industrial purposes. Thirty years ago he urged on his Company the importance of letting out fittings and apparatus on hire, and this was done to a considerable extent, so much so as to seriously affect the capital at their disposal, for in four or five years they had something like £7000 invested in gas-fittings and apparatus let on hire. He could fully substantiate the importance of there being a separate meter to the gas-cooking apparatus. He had fitted up a stove for a large scholastic establishment, to cook for 300 people, and the plan he recommended to the principal was to watch the consumption day by day, and endeavour to bring it down. After a week or two's experience, he found that the consumption was gradually being diminished, and when he thought he had arrived at a minimum, he offered the cook a premium for all the gas he might save below that quantity. The result was most satisfactory, and the cooking of this large establishment was conducted very economically. He was quite sure that when a good supply of gas was carried to the cooking apparatus, where the consumption was separately registered, and a careful superintendence of the fittings was made, it would be found very economical. One great difficulty they had found was that the cooks left the gas burning when they had nothing to cook, and the consequence was it often appeared to be very expensive, whereas it might be rendered very cheap.

Mr. W. Bates (Worksop) asked what pressure was required at the lowest point of a district to ensure efficiency in gas-stoves. He suggested whether it would not be advisable for companies to provide separate meters without charge, and, perhaps, even to charge less for gas for cooking purposes, so as to induce consumers to use it in this way.

Mr. C. Gandon (Sydenham) said he could fully endorse the remarks that had been made as to the advantages derived by gas companies offering facilities for pushing gas cooking. At the same time, there was a great deal in what was said as to the care required in supervision. In his own house he frequently went into the kitchen and found the gas on when it was quite unnecessary, and so long as such waste as that continued, the use of gas must be disadvantageous to the consumer. A separate service and meter would do much to prevent waste, especially if observations were frequently taken, because then the consumers could be informed of what was going on. With regard to letting out stoves on the three years system, he had no doubt that would be most advantageous to the companies if they could induce consumers to adopt them; but so long as they had the opportunity of taking them at a rental, he thought there would be a difficulty in inducing them to purchase. He was informed recently that a company had offered such facilities, and that they had received no applications whatever to purchase on the three years system, but numerous applications had been received for the hire of stoves. It was said that 5-10ths of an inch of pressure was sufficient. In his opinion, however, the pressure should be rather more; but most companies gave more than 5-10ths as the ordinary day pressure. With an ample supply-pipe, 5 or 7-10ths was quite sufficient.

Mr. Magnus Ohren (Sydenham) said that the waste in cooking-stoves was not so great now as formerly. Whenever stoves were fixed by his Company they gave the consumers information how to use them, and drew their attention to the danger there might be in trusting the stoves entirely to servants. He remembered one case where a very large account was sent in—about £20 for one quarter, instead of about £5 as usual. The customer said there must be something wrong; the matter was inquired into, and it was found that the cook had never turned out the gas at all; but, after having once lighted it, she thought it was very handy to have it always going, in case it might be wanted. In another case a gentleman had an open gas fire supplied to his nursery. His (Mr. Ohren's) advice to him was, that the servants should be charged to be careful in its use, for he told him it would be rather costly if used more than the time stated—an hour in the morning and evening. He repeated that it would be only required for a short time in the morning and evening, when the children were getting up and going to bed, and so the stove was fitted. At the end of the quarter the account was very large. The consumer called at the office to complain. He was very angry, and said he had been misled. He still insisted that the gas fire was only used for a short time, morning

and evening; but he (Mr. Ohren) persuaded the gentleman to go back with him and up to the nursery, and there they found the two nurses sitting warming themselves before the full blaze of the gas fire. Thus the mystery was explained—the stove had been used constantly, as he (Mr. Ohren) expected.

Mr. G. Helps (Bath) said cooking by gas had been going on for a long time in Bath, but in no case had they a separate service or separate meter. He generally noticed that if there was any fault found with the cooking or heating stove it was when the mains or services were defective, and if they were looked after, and the pressure kept at the proper height, there was no difficulty whatever. The number of gas-stoves and fires in Bath was constantly increasing. One reason, perhaps, was that in Bath the price of gas was as low as in most places, therefore the bills did not appear so large as in some towns. They had cases in private houses where £10, £15, and £25 per quarter was paid for gas for heating purposes alone, not for cooking. He thought putting separate services would only annoy people, and was quite needless.

Mr. R. O. Paterson (Cheltenham) said that what he had to remark had been almost anticipated by Mr. Helps. Like all gas managers, he felt much interest in this question, and was obliged to Mr. Travers for his suggestions; but it did not seem to him that a separate supply was a wise thing to recommend. If there was anything in the supply militating against the introduction of gas for heating or cooking, the better plan would be to increase the one supply, so as to make it ample for all purposes, whether for lighting, heating, or cooking, instead of doubling the service. There was always a considerable amount of leakage going on, and every point where a junction was made increased the tendency to leakage, so that he should object to put a second service into a house simply for the purpose of cooking or heating. There was always a tendency to increase the number of lights, and consumers often got beyond the capacity of the services. The enlarged service-pipe would also meet this difficulty. Another important point was how cheap the gas could be supplied, and he thought that that was the chief direction in which they should turn their attention. The cheaper they could supply it the more it would be used for cooking, heating, and lighting. In Cheltenham they had a most intelligent and enterprising Company, and they had contrived to sell gas at an extremely low rate—a matter which really was worthy of the greatest energies of each member of the Association.

Mr. H. Woodall (Leeds) said there was one point which had not been mentioned, and that was the economy with regard to the meat cooked. He had recently cooked two legs of mutton from the same sheep, one before the fire and the other in a gas-oven. The cost of the gas was ½d., and the saving in the weight of meat was 1s. 7d.; so that in cooking a leg of mutton the saving was 1s. 6½d. beyond the gas employed.

Mr. J. Hepworth (Carlisle) hoped one suggestion in the paper would bear valuable fruit—viz., that experiments should be made with regard to the comparative efficiency of gas-stoves and cookers. They all knew there were burners *and* burners, and so there were various qualities of gas-cookers. It was exceedingly desirable, not only to see that the service-pipes were good, but that the stoves were what they were represented to be before they were sent out.

Mr. G. B. Irons (Gosport) was particularly anxious to call attention to the suggestion of Mr. Lane as to the necessity of testing the power of gas in gas-stoves. In London and other large places they had been fighting this question for many years, and he thought they had come to something like an understanding of what the standard requirements were; but it was not so in a great number of small towns, and the consumers of gas who desired to cook were often in doubt whether they should follow the advice of the gas manager or of the gas-fitter. He thought it would be a good function on the part of the Association if they could furnish gas managers with something like a standard of the supply required for certain purposes. If they turned to Clegg they could find what a certain pipe would deliver at a certain pressure; but what gas managers required was something like an authority which would support their opinions, and enable their judgment to have due weight.

Mr. Travers, in reply, said that in Cork they had a person to go round regularly and give instructions. He also had charge of the stoves, and all matters connected with them. With regard to pressure, he (Mr. Travers) considered 6-10ths of an inch ample for all purposes. He did not advocate a separate service from the main, but put a T-piece on the pipe from the meter, and from that lead the pipe to the stove. He certainly should have included the subject of roasting in the paper, but gas-stoves were not generally used for roasting purposes. With regard to the stoves themselves, he wished to remark that the previous week he had an opportunity of testing a very excellent stove, in which there was an improvement to which he would call attention. After turning on the gas, the temperature could be raised to 400° Fahr. in about 15 minutes, and there was then an arrangement by which the gas could be lowered so that, at one-third of the consumption, the heat could be maintained for any length of time at about 350° Fahr. That was certainly a step in the right direction. On his way to the meeting he noticed some parties interested in opposing gas cooking did not fairly represent the case, for they stated that gas cooking could be done for ten persons at 7s. per week, whereas he knew a place where cooking for 30 times that number was done for exactly that sum. He only regretted that some abler member had not taken up the subject of his paper, and trusted that by another year it would be more looked into.

The President thought that gas companies could not do better than teach those who used gas for heating purposes how to economize it as much as possible.

Mr. W. Sugg (London) read a paper on

LIGHTING BY GAS AND ELECTRICITY.

In the early part of last year it was proposed to light the Avenue de l'Opéra in Paris by means of electricity instead of by gas. Already the Jablochkoff electric candle had been shown to a few scientific men, and a Company had been formed to bring out the new invention, which appeared to be simplicity itself. There was an apparatus producing an electric light without the well-known Serrin clockwork lamp, to which scientific men had been accustomed since the days of Holmes and others. Evidently this was a new point of departure in electric lighting, and as such it was hailed by scientific men.

It was not at first seen that electricity would enter into competition with gas as a means of street lighting, but as soon as the Company was formed, regular exhibitions of the new electric light were given at the works of the Company in the Avenue de Villiers, and comparisons were instituted between the new light and gaslight. The comparisons, as I then saw, were most unfairly made, the gas being placed at about 15 feet from the floor of the room in which the trials of the lights were conducted, while the electric light was at only 7 feet from the ground. Four of the new lights were placed on 7-feet standards, and two large chandeliers, each having a number of common iron burners of the most gas-destroying type, were hung from the ceiling; the lights being, as I have said, about 15 feet from the ground. Supposing the two chandeliers were hung from the ceiling, so that the lights were at the same level as the electric lights, I think the amount of light given by them would have been about equal to that given by the electric light. But it is clear that in the comparison made, at the distances I have mentioned, the gas was most heavily handicapped. I do not mean to infer that the Electric Light Company designedly selected the worst burners to try against the electric light; on the contrary, I have reason to believe that the lights were such as might be bought anywhere in Paris, and, in fact, were such as were generally used in *cafés* and other large public rooms. As gaslight of an ordinary type, it was fair to take them as samples. The only unfair part of the comparison was the manner in which the gas was placed in the competition with electric light. I more particularly mention this first occasion, because I have found since, in almost every case in which experiments have been made by electricians against gas, there have been equally unfair means taken to depreciate gas, and show an untrue effect with the electric light.

I think experiments made in this manner are utterly unworthy of scientific men, and the effect of such one-sided work is to debase science in the eyes of the general public. Gas and electricity must stand or fall by their merits, and it is of no more use to endeavour to bolster up a defective system of lighting by false statements and one-sided experiments, than to stand idly by and let the public be misinformed without an attempt to put them in possession of the true facts of the case.

One thing is certain, and that is, that after the preliminary trials I have mentioned, both scientific men and the public, overlooking all its defects which were said to be of a temporary character, were entirely carried away by their enthusiasm for the new light. It was resolved by the Municipality to light the Avenue de l'Opéra with the new light during the Exhibition, and a fixed price having been agreed upon between the parties, this magnificent new street was at the opening of the Exhibition supplied with 63 of the Jablochkoff lights.

Notwithstanding the lamentable unsteadiness of the electric light, it found favour with the public, because it was immensely superior to the ordinary flickering yellow gas lights. It evidently fulfilled a latent desire on the part of the Parisian public for more light in their most frequented thoroughfares. The oxygen light of Tessié du Motay, which had been withdrawn after a short trial, had left them unsatisfied, and till the advent of the electric light, a considerable time had elapsed without any initiative having been taken by the Paris Gas Company to show an improved system of gas lighting. Therefore it was, I think, that the electric light, thus answering to the latent desire on the part of the public, met with a more enthusiastic reception than it otherwise would; more even than it merited, for the light was most irregular in illuminating power, varying as much as 50 per cent. in the space of a few minutes. Indeed, it cannot be said that even for a single minute was it constant. A large gas light working on a very bad meter with a little water in the service would more nearly express the irregularities of the electric light than anything else. The illuminating power of these lights was stated to be equal to that obtainable from 700 to 800 candles. We now know that this was a gross exaggeration, but it illustrates how much scientific men were carried beyond the power of reason by their enthusiasm for the new light. As a mode of street lighting it failed in a most important requirement: It was not continuous during the hours between sunset and sunrise. At midnight it was extinguished, and the regular gas lanterns were called into requisition to carry on the lighting till sunrise. Thus a double system of gas lighting and electricity had to be maintained.

Some among us had the pleasure of visiting Paris after the meeting of this Association last year, in company with three American gentlemen who now form part of the British Association of Gas Managers. Major Dresser, Greenough, and Forstall have left behind them most agreeable memories, and have, as it were, linked us to our American brethren in a tangible manner. We now feel that in all our meetings they will be present with us in thought, and in our work and discussion we address ourselves to them as well as to those who are present. In company with these gentlemen and others, including your late President, Mr. C. Woodall, who has devoted a considerable amount of time and trouble to the investigation of the modes of electric and gas lighting in use, we made a careful examination of all the systems of electric lighting in use in Paris at the time of our visit. We were all struck with the fact that the large amount of light which was stated to be given by the electric lights did not appear to be present; the volume of light fell far short of our idea of what it ought to be, if the statement made by the electricians was correct. We soon came to the conclusion that it was not correct, and subsequent experiments, made by M. Leblanc, the Chief Gas Examiner of Paris, have confirmed us in our idea of the real illuminating power given by the electric light. We thought that the amount of light could not exceed at any time more than 150 candles from one light. We now find that it does not average more than 120 candles. The public were therefore very much misled by the statements made at the first appearance of the light.

I regret to have to say that even at the present time electricians do not seem to have made up their minds to state with anything approaching to accuracy what is the real illuminating power of their lights. It is next to impossible to obtain any reliable information as to the cost or illuminating power of any of these systems. I will mention an example of the nervousness of electricians as to this question of illuminating power. At the recent Exhibition of Electric Lighting Apparatus at the Albert Hall, there were two electric light photometers exhibited—one by Mr. Keates, and the other by myself. Although the authorities invited the electricians to bring their lamps to be tested for illuminating power, and Mr. Keates's assistant kindly attended to try them, yet it was found impossible to get the electricians to be ready, simultaneously with the exhibitors of the engines which worked the electric machines. When the engineers were there, the electricians were not, and *vice versâ;* so the trials had to be given up. I have, therefore, for the purposes of this paper, compared the sometimes slightly conflicting evidence of those who have made trials of the electric lights in various places, in order to give you the best idea of the relative positions of the two lights as they stand to each other at present, and I then propose to make some remarks upon the future of the gas and electric light.

First, I will take the Avenue de l'Opéra. There were in all 62 electric lamps in the Avenue. The machines setting in motion the current of electricity producing the light were what are called the "Double Gramme." The length of the Avenue is nearly 1000 yards; the width of the road from house to house is 90 feet; the width of the carriage-way is 50 feet. The Place de l'Opéra, at its intersection with the Boulevards, is 200 feet from house to house, and 450 feet long. This Place is lighted by 22 Jablochkoff lamps, and the machine producing the electric current creating the lights is worked by a 20-horse nominal engine, fixed in the basement of the Opera House. The next section of 16 lamps is worked from a Double Gramme machine, driven by an engine of 20-horse power fixed in the Rue Gaillon. The next section, also of 16 lamps, is worked from a Gramme machine and a 20-horse power engine fixed in the Rue d'Argenteuil. The last section consists of the lamps in the Place du Théâtre Français. They are 14 in number, and the engine and machine for them are fixed in the basement of one of the houses in the Avenue. Each of the lamps is provided with four candles, only one of which is burning at a time. The whole four are enclosed in an albatrine or white glass globe, about 18 inches in dia-

meter. One of these candles burns a little over an hour. At the end of that time the current must be switched off, from the one which has been burnt down, to the fresh one next it. So it is necessary that an attendant shall go to every lamp once in an hour, and turn on the current to the new candle. The lamps are lighted at about an hour after sundown, and are all extinguished at midnight. The gas-lamps, if they are not already lighted up, must then be put into requisition, to carry on the lighting till sunrise.

According to the official report, from the 30th of May to the 10th of October, 1878, a little over four months, there were no less than 60 extinctions, lasting from 1, 2, 3, 5, or 10 minutes, up to 15, 30, or 45 minutes. The Company, it is said, hope to do better. There are no fines to pay if they do let the lights out, and the Paris Gas Company are kind enough to light up whenever the electricity is indisposed.

The amount of light given by each of these lights is stated by M. Leblanc and M. Th. Lévy to be, when they tried it at the Avenue de Villiers, equal to that given by 285 candles, in a horizontal line, when the Jablochkoff candle is not covered by an albatrine globe. This light is too painful to the eyes, and from its want of volume it is useless for lighting streets or houses. To render it useful it must therefore be surrounded with an albatrine globe, and then the amount of light given in a horizontal line is said by these gentlemen to have been equal to from 171 to 190 candles; but the electric light does not, like an Argand burner, give its light equally in all directions. Sometimes the voltaic arc is nearer to the screen at the front of the candles, and at others it is at the back of the candles. I need not tell you that on a short photometer, such as has hitherto been used in testing the power of the electric light, this little distance makes a very important difference. Such a very exact *savant* as M. Leblanc would, however, be very unlikely to overlook these points, yet I do not think he would be disposed to give so much credence to these experiments as if they were regularly made every day, just as gas is tested. But he found that although the light in a horizontal direction was equal to what I have stated, yet that effective light given on the ground in a diagonal direction was only equal, in round numbers, to 115 candles; so that in practice, although the beautiful white fronts of the houses in the Avenue de l'Opéra were lighted to the extent of, on an average, about 160 candles, yet on the ground there was only the light of 115 candles.

It is remarkable that in the experiments carried out at Westgate-on-Sea by Messrs. Bennett and Valon, they found that the light given in a horizontal line by a Jablochkoff lamp was there equal to 197 candles. The difference between their experiment and that I have mentioned is easily to be accounted for by a possible difference in the speed of their engine and that used in Paris. I think that in all estimations of the electric light the speed of the dynamo machine ought to be taken, as well as the number of lights in the circuit at the time of the trial, simultaneously with the photometrical experiments. This has a most important bearing on the question of cost.

Now as to this question of cost. This is, as told me by an eminent Paris electrician, a very delicate question. I shall give it you in figures founded on my own experience and observation, checked by those of the most experienced engineers who have tried it.

M. Th. Lévy estimates that his experiments show that to obtain a light of one Jablochkoff lamp, producing the effect of 115 candles on the ground, it is necessary to employ the force of 1½-horse power when there are 16 lights burning produced by the force of a 20-horse power engine. This is corroborated by the experiments of Messrs. Bennett and Valon, who obtained six lights of little more than that obtained by Messrs. Leblanc and Lévy, with a force of rather over 10-horse power, or at the rate of one light for 1·6-horse power. This is further corroborated by Messrs. Keates and Bazalgette. So we may take it that we could get one light of 120 candles in all directions for 1½-horse power. The Electric Light Company say they hope to get three lights from 1-horse power, but how they are going to do it, and what is to be the power of these lights, they do not condescend to inform the world. Thus the 62 lights in the Avenue de l'Opéra require 92-horse power to keep them going.

I need only say, with respect to the hopes of the Electric Light Company, that, considering the very conclusive experiment of Dr. Hopkinson, given in evidence before the Select Committee on Lighting by Electricity, shows the conversion of motive force into light to be so perfect with the Siemens dynamo machine, that the astonishing result of 90 per cent. in light is obtained from the motive force employed, these hopes are doomed never to be realized. The total amount of light obtained from the 62 lights is at the rate of 120 candles per light all round, or 7440 candles.

Table No. 2, appended to this paper, is my estimate of the cost of the electric lighting in the Avenue de l'Opéra, taking the figures, as to the working expenses, of M. Lévy, and adding the capital charges and interest on the capital expended. This, you see, amounts to the sum of £19 11s. 4½d. per hour for the 62 lamps, or 6s. 3¾d. per lamp per hour. But we were told by the Chairman of the House of Commons Committee on Lighting by Electricity that the commercial value of the electric light is that which the Electric Light Company charge for it. Now, without disputing his dictum, it seems to me that we, as gas engineers, are at liberty to examine into the cost ourselves, and this I have laid before you for your information and criticism.

I now address myself to the comparison of gas and electricity as a means of lighting the Avenue de l'Opéra. The Electric Light Company of Paris have undertaken to light the Avenue de l'Opéra for the period of one year, beginning from the 15th of January, 1879, for the sum of 3d. per light per hour, including all charges. The total cost of the 62 lights is therefore 18 fr. 60 c. per hour, or, in English money, 15s. 4d. Now for this sum they give a light which is, as I have stated, imperfect in almost every requirement for street lighting, and which must have all the regular arrangements of gas lighting to do the work when the electricians are gone to bed, or when they cannot get their capricious apparatus to work. To the cost of the electric light, high as it appears to be, must be added the cost of the installation of the gas, and the cost of gas for the 2000 hours in the year from midnight to sunrise. This will be 620,000 cubic feet, *plus* the lamplighters wages.

The number of gas-burners replaced by the electric lights was 344, each burning 5 cubic feet per hour. Each of these jets gave an effective light on the ground equal to 10 candles, or a total of 3440 candles; consequently the electric lights gave a light of 4000 candles more than the gas. The Paris gas-burners do not, however, do as much good with the gas as they ought. They are all iron burners. If the 1720 cubic feet of gas consumed by the 344 burners had been consumed in the 200-candle burners such as shown here, they would have given the light of at least 6500 candles for that quantity of gas, or only 900 candles less than that given by the electric lights; so that if forty 200-candle burners had been placed on the columns on the Boulevards and in front of the Opera, instead of the electric lights, there might be a continuous, steady, bright, white light, superior to the electric light, for a trifle more than the gas cost before.

The actual position of these lights might be as follows:—Six globe lanterns on the ornamental columns in front of the *façade* of the Grand Opéra, fitted with burners consuming 25 cubic feet per hour, and giving the light of 90 candles each. Eight lanterns of a globular form, one on each of the safety posts in the Place de l'Opéra, each of these to have a burner consuming 56 feet of gas per hour, and giving a light of 200 candles each. Six lamps fixed in the Place du Théâtre Français, fitted with burners each consuming 56 cubic feet per hour, and giving the light of 200 candles each; and 23 in the Avenue, fixed on columns, the same pattern as the Paris columns, but 15 feet high, placed in the centre of the carriage-way, each lamp constituting a refuge. These would each burn 56 feet of gas per hour, and give the light of 200 candles each. The total quantity of gas consumed for the entire lighting would be 2222 cubic feet, and the total amount of light in candles would be 7940, or 500 candles *more* than can be produced by the electricity.

Thus, by this new system of lighting, the excess of the consumption of 502 cubic feet per hour over the usual amount consumed before the advent of the electric light—viz., 1720 cubic feet per hour—the Parisians might have a better light, perfectly steady, reliable, and working from sunset till sunrise without attendance, superior in illuminating power by 500 candles to the electric light, with all its trouble in engines, machines, and attendants. Further than this, the unanimous verdict of the public is that the gaslight thus produced is soft and agreeable to the eyes, which the electric light is not.

The cost of the old gas lighting by 344 burners was 7 fr. 22 c. per hour for the entire Avenue, the Place de l'Opéra, and the *façade* of the Opera, and the light given was 3440 candles. The cost of the electric lighting for doing the same work is, at the present price charged by the Electric Light Company, 18 fr. 60 c., and the light given is 7440 candles, or 4000 candles more than the old gas lighting. Thus the illuminating power is increased 186 per cent., and the cost is increased 163 per cent. Now you perceive why you did not see the great difference which you were led to expect from the exaggerated statements which had been made in the public journals of France and England about the incredible number of candles given by the electric light, when at midnight the electricity was replaced by gas. The 50,000 candles at first talked about has dwindled down to 7440 candles. If, however, the 1720 cubic feet of gas formerly consumed by the 344 old 5-feet per hour burners had been consumed in such new Argand burners as I have before mentioned, the result would have been a production of light equal to 6880 candles, or only 560 candles less than that given by the electric lights which superseded those gaslights. Thus, the increase in light produced by the electricity is only 12 per cent. more than might have been produced from a proper use of gas, while the loss, at the exceeding low figure of 7 fr. 22 c. per hour for the 62 lights, shows an increase of 125 per cent. on the cost of gas to produce the same amount of light. The cost of the new lighting by gas which I have proposed, and which I have demonstrated to you is practicable, will be 9 fr. 42 c., or less than half the price now being paid by the Municipality for the imperfect lighting by electricity. All this bother of electric machines, engines, and candles results in the expenditure by the Paris Municipality of a large sum of money for doing in an inefficient manner the work which can be efficiently performed by the Paris Gas Company for less than half the money, without any bother at all.

Is it not clear that if the Paris Gas Company could have come forward in the first instance, and said they were able to give this superior light for the small sum of money just mentioned, the Avenue de l'Opéra would in all probability have never been lighted by electricity? and this more surely because the gas being first fixed, and constituting the standard, the public would never have accepted the flickering and uncertain electric light in place of the steady and brilliant gas lights. Unfortunately, there were only the old flickering yellow bat's-wing burners to represent gas, and the electric light had it all its own way; but in the end the best and cheapest must win, and that is in the future for gas.

It is said of the late Duke of Wellington that, being present at a trial of gun-cotton, which it was predicted would supersede gunpowder, and finding the destructive effect it had on the gun from which it was fired, he quietly remarked before going away, "What a splendid improvement gunpowder would have been on gun-cotton, if gun-cotton had been invented first." So we might say with regard to street lighting by gas and electricity.

In the Rue du Quatre Septembre, a street about half the length of the Avenue de l'Opéra, the Paris Gas Company have put up 80 lanterns, with burners composed of a ring of flat-flame iron burners, each burner consuming nearly 50 cubic feet of gas per hour. The total quantity burned by the 80 burners is 112 cubic mètres, or 3923 cubic feet per hour. Each of these burners gives, it is said, the light of 125 candles. The light given by all the 80 burners is, therefore, 10,000 candles, or 2560 candles more than the electric light in the Avenue de l'Opéra. Now, if this quantity of gas were consumed in sixty 200-candle burners, the amount of light obtained would be equal to 12,000 candles, or 4560 candles more than that obtained from the electric light in the Avenue de l'Opéra. (Note that the Rue du Quatre Septembre is only half the length of the Avenue de l'Opéra.) The real cost of this lighting, at the rate for gas paid by the Municipality, is 16 fr. 80 c. per hour. The Paris Gas Company are only charging one-third of this sum, regarding the new light as being an experiment; but I think it would be much better if they would consider it as a serious mode of lighting, and give light for light and lamp for lamp, in comparison with the electric light.

In the Place du Château d'Eau there are 77 lamps fitted with gas-burners; 19 of these burn 114 litres of gas per hour, and the other 58 burn from 740 to 800 litres per hour.

In the Halles Centrales there are two pavilions lighted—one by electricity, the other by gas. They are both lighted for 4000 hours per annum, or from sunset to sunrise. In the pavilion or quarter of the building devoted to the electric light, there are six electric lights burning at a cost of 1 fr. 80 c.; or about 1s. 6d. per hour for the six lights, and the amount of light given is equal to 720 candles. The old lighting by gas was done by 20 bat's-wing burners, each consuming 5 cubic feet per hour, and the total amount of light given was 200 candles, at a cost of 42 centimes per hour, or 4d. for the 20 lights per hour. Now, if six burners of 120-candle power each, and consuming 35 cubic feet per hour each, were fixed in the place of the electric lights, they would produce the 720 candles for the sum of 90 centimes, or 9d. per hour for the entire lighting, instead of nearly 18d., for the same work done badly by the electric light. (Note that there were 24 extinctions and 54 electric lamps out in the month of April last, the gas having burned steadily from the time it was commenced, without any extinctions or wavering.)

I shall not take up your time by any consideration of the lighting of the Magasins du Louvre by electricity as compared with gas, or the lighting of the Hippodrome. With respect to the Magasins du Louvre, it is more than probable that the question of cost, or even efficiency, does not enter into the calculations of the proprietor. Those who have seen this vast shop, where everything is sold, must have observed that the gas lighting is primitive. The lustres and brackets are massive and even gorgeous, but as an example of the comparative effect of lighting by gas and electricity, it is about the same as a comparison between the old Roman lamp with that perfection of an oil lamp, the Carcel. Besides, the electric light has been for this establishment, as well as for others in this country, an excellent advertisement. It is a matter of little importance whether the light is reliable or not, there is always the gas lighted and ready to be turned up at a moment's notice when the electric lamps go out. In most cases the

gas and electricity are kept going together. I believe the assistants complain bitterly of the electric light, and ladies say it is not good as regards matching colours.

The Hippodrome is a large circus, fitted with a sliding roof, so that in the summer the performance is under the open sky. Here again the building is fitted for gas as well as electricity. There are two systems of electricity, one being the Jablochkoff and the other the ordinary point-to-point carbons. The volume of light is here very deficient, and I have no doubt that when the novelty of the electric light has worn out, the management will have to supersede the electricity with gas, or use both gas and electricity simultaneously.

Coming now to the attempt to supersede gas by electricity in this country, I take first the lighting of the Albert Hall, because evidence upon this subject has been given before the House of Commons Committee on the Electric Light, by a very high authority—I allude to Dr. Siemens. It is difficult to imagine how the learned Doctor arrives at some of the astonishing statements he has made with respect to gas. But this paper would be most incomplete if it did not make an attempt to place before you some of the statements made, so as to bring them into the scope of the discussion, with a view to obtain an expression of opinion from some of the members of this Association, whose practical knowledge of gas-making is considerably in advance of that which could be possessed by the learned Doctor.

Dr. Siemens, in his comparison of gas with electricity, takes as the unit of comparison 1000 standard candles of light per hour. He then states (Question 136), "That an Argand burner produces 1000 candles of light per hour, with a consumption of 312 cubic feet of gas, and to make this gas, 56 lbs. of coal would have to be used in the retort." Here I think I see a grave error; 312·5 cubic feet of gas from 56 lbs. of coal is 12,500 cubic feet to the ton; therefore I think the Doctor must have been speaking of cannel coal, probably Lesmahagow. This would be 30-candle gas at least; 312·5 cubic feet of such gas will give at least 2031¼ standard candles. As he has taken electricity in its most scientific form, so, for a fair comparison, must he take gas in its at present most perfect system of burning. If we burn the gas in such burners as you see here on the table, you can get the light of 6½ candles from every cubic foot of 30-candle gas. Mr. King, of Liverpool, whom you will doubtless consider a better authority on this subject than even Dr. Siemens, has stated that he has obtained 5·1 candles from a cubic foot of 22-candle gas.

Dr. Siemens further states that he found that with a gas-engine (I presume an Otto engine) he obtained the light of 1000 candles with an expenditure of 151 cubic feet of gas. This would be a development of 4-horse power to do this work with one of his own dynamo machines, which I consider the most powerful, and this accords exactly with the experiments that were made by me under the direction of the Lighting Committee of The Gaslight and Coke Company. We found that with a small Siemens machine we produced an average light of 1000 candles with an indicated power of four horses, and with a consumption of 40 cubic feet of gas per hour, the illuminating power and indications of horse power being taken simultaneously. 37 cubic feet of 30-candle would certainly do as much work as 40 feet of 16-candle gas. In fact, I am certain that if the air supply of the engine had been properly regulated for the quality of the gas, it would have been found that 30 cubic feet per hour would have done the work. From this it is clear that the conversion of gas lighting power into electric force does not work out so advantageously as it was thought to do.

Dr. Siemens says that 151 cubic feet of gas is produced from 25·2 lbs. of coal, and he deduces from this calculation that if 25 lbs. of coal be used to produce gas, and that gas is applied to work a gas-engine, it will produce as much light as 56 lbs. of coal converted into gas would do, if it were burned in gas-burners to produce light directly. I think I have shown that the Doctor's figures are capable of another interpretation. Gas-making is not a wasteful or an unscientific mode of producing illuminating power. In making his comparison of what can be done with 56 lbs. of coal in producing the electric light, Dr. Siemens does not take into consideration that in using his coal to produce steam, and with that force producing the electric light, the whole of his material is used up, leaving nothing but dust as a residual. On the contrary, in using the 56 lbs. of coal to produce gas, he obtains 312·5 cubic feet of gas, and he has a quantity of coke and tar, besides ammoniacal liquor. If the net value of these products is taken into the calculation, quite another view of the matter will be shown. I think that, taking into consideration the ease with which gas is conveyed into every nook and corner of towns, it will be found better to burn gas to produce light, which can be managed by any unskilled person, and divided into any size flame without much loss, than convert its force into a motive power to produce electric lights, which cannot be divided into small lights without great loss, and which require highly-trained hands to manipulate them.

I regret that the limits of this paper do not permit me to go so fully into the lighting of the Albert Hall as I could wish. This hall is lighted usually by gas, by means of 30 of what may be called sun burners suspended from the roof. Each of these has a total of 105 small fishtail iron jets. Thus we have a grand total of 3150 of these small fishtail jets in the aggregate number of 30 sun burners. These sun burners have no reflectors, but the light given from them is a little assisted by a whitened coved ceiling. The consumption of all the sun burners, at the rate of 2·5 cubic feet per hour for each jet, is 7875 cubic feet. With such burners a cubic foot of 11-candle gas will only give the light of 1·5 spermaceti candles, or 7·5 candles per 5 cubic feet of gas burned.

The total amount of light in spermaceti candles is 11,862·5 candles. The lights in the arcade round the upper gallery are 23 in number, with 5 iron jets in each, which give the light of 2 candles per cubic foot of gas consumed. The total consumption of these burners is 460 cubic feet, and the light given for it is 920 candles in all. Thus the total amount of gas consumed in an evening of three hours is 25,000 feet, and the total amount of light given by this very unscientific lighting is for each hour, with a consumption of 8335 cubic feet of gas, 12,785 candles. With this the highly scientific electric light is compared, and without taking into consideration any charge for the engine to drive five Siemens dynamo machines, which, small as they are, will need a full-size 30-horse power engine to work them, without any charge for the copper leading wires or for the lamps, five in number, and ignoring any charges for rental or interest on capital, it is gravely stated in evidence, on high scientific authority, that there is a considerable saving effected if this building, and, by inference, similar buildings, are lighted by electricity instead of gas. I say that such misleading statements are unscientific and unfair. In the first place, it cannot be seriously entertained for a moment, by any scientific man, that such a whizzing, fizzing, screaming, roaring, fluttering, and sputtering concern as these five lamps, could be accepted by the public as a permanent mode of lighting.

I was present at the lecture given, on the occasion of the exhibition at the Albert Hall, by Mr. Preece, a gentleman whose unbiassed and highly practical opinion, given, as it is at all times, on any practical question, with the most perfect clearness and evidence of a thorough understanding of the subject, affords the highest pleasure to every one who hears him. After the lecturer had described the different machines and lights (which by-the-by were most uncontrollable, even in the presence of Royalty), these large lamps were lighted up, and the noise they made—more than sufficiently audible even on the platform—very sensibly affected the Duke of Edinburgh in a speech he made thanking the lecturer. I was even led to believe myself that some of the audience in the gallery were hissing. What the effect of these ill-behaved, spoiled scientific pets would have been on the sensitive, nervous temperament of a *prima donna*, it is too much to contemplate.

Much has been said on the question of the improvement of the acoustic properties of the Albert Hall by the use of the electric light; but really until some means have been discovered to make the light burn steadily and without noise, it sounds like a dismal joke to mention such a thing.

In its present state, it is not worth while to go into the question of the cost of the electric light at the Albert Hall. I shall defer that consideration till I see that it can seriously enter into competition with gas to light the Hall. But I will tell you what can be done with 2500 cubic feet of gas consumed in three hours, for lighting the Hall, if it is employed as we can now apply it. This quantity of gas, burned in such Argand burners as you see before you, will easily produce from 16-candle gas a total of 100,000 candles of light, or more than 33,000 candles per hour. Now observe that it is also possible to use these burners in lamps which take their supply of air from outside the hall, and return the vitiated air to the exterior of the building, so that the air of the interior is not affected in any way by the products of the gas, or by the air required to promote combustion. So the acoustic properties of the Hall may be as good with gas as with electricity. This light is steady, constant, white, and pure. Remark that, unlike the vaunted purity of the electric light, it does not require gold reflectors to neutralize its ghastly paleness.

Now what can the electricians offer comparable to this? It is stated that the light given by each electric light is equal to 6000 candles, and that the grand flood of light from them is equal to a total of 30,000 candles. I pledge you my word, as a photometrician, that if this be so they must be the very smallest parliamentary candles I have ever seen.

On the evening of Mr. Preece's lecture, your late President and other eminent men, who had a perfect knowledge of the subject, were present, and they remarked with me that the 30 sun burners alone, unassisted by the arcade lights, were nearly, if not quite equal to the electric lights in the volume of light they gave. It is true that the concentrated power of the gold reflectors of the electric light caused a greater amount of light to fall on the floor of the arena, but the total lighting of the hall was little better than the light given by the gas. Now the light from the 30 sun burners we know to be not more than, in round numbers, 12,000 parliamentary candles. This result is extraordinary, and we should be surprised at it if we did not know that the electric light does not possess the volume of light that the gas does for an equal measured amount of light. It is, therefore, clear that for lighting such a building the gas is superior in every respect to the electric light, and if it is desired by the Commissioners of the Albert Hall, they can, by improved modes of using it, certainly obtain that success with gas which I think they will long desire to obtain from electricity.

For lighting streets and large spaces I entirely dissent from the view taken by the authorities who have said that electricity is more convenient and suitable than gas. The elaborate experiments carried out in Paris and on the Thames Embankment do not establish this as a fact, but quite the contrary. Since it is impossible to obtain complete official information as to the entire cost of the electric light, either on the Thames Embankment or in the Avenue de l'Opéra, we adopt the view taken by the Right Hon. Lyon Playfair, that the commercial value is what the Electric Light Company are willing to take for it. Thus on the Thames Embankment the price charged is 5d. per hour for the same thing which costs the highly favoured Municipality of Paris 3d.

Now, if it is desired by the Metropolitan Board of Works to light the Thames Embankment efficiently, and to the same extent as it is now done by the electric light, they need not go to the trouble of putting up a magnificent engine, or disfiguring the architectural beauty of this very grand work by magnied cobwebs from lamp to lamp, or lamps with reflectors *à la tête du cardinal*. All they have to do is to order in place of each electric light a gas lamp and burner, giving a light of 120 candles at a cost for each lamp of 1½d. per hour, including all charges, and the work will be efficiently done without any trouble to the Board. Better still, and much more worthy of London's beautiful promenade by the river, the Board, if they are disposed to pay to the Gas Company half of what they now pay to the Electric Light Company, can have a globe lamp with a 100-candle burner on every one of the handsome columns fixed on the Embankment, instead of only on every other one as at present, thereby producing a very much better effect in every way than they can possibly hope to do with the electric light.

What gas can do in the way of street lighting and in lighting large spaces is abundantly and clearly shown in Queen Victoria Street, City, the lighting of which I claim to be superior in every way to that of the Avenue de l'Opéra, and in this I am borne out by the verdict of the public. Yet the total cost of that lighting is only three times the cost of the old system of lighting by the usual 5-feet per hour burners, and the total amount of light given in the street is 3400 candles by the new mode of lighting, as against 660 candles by the old. Thus the cost is three times the old rate, and the illuminating power is six times greater than before. Such lighting is not too much for the busy streets of London, in which there is at night a traffic of pedestrians and vehicles considerably greater than in any other city in the world.

The public imperatively demand an improved street lighting, and, as is clearly shown by the large sums expended on the electric light, are prepared to pay the value for it. It is our work to show how gas can be utilized for this purpose to the fullest possible extent, and, with as little increase in the present cost as we can, to give an improved lighting. But at the same time it must be borne in mind that the action of the local authorities in many places has been to decrease the amount of light, while the increase of night traffic has gone on from year to year.

Reverting to first principles, I have taken, for the purposes of illustrating what public lighting is and should be, a certain standard. This standard is a man lighting his way with a lantern. The light is fixed to a stick, in the manner most approved by our ancestors; it is, in fact, so used in the country at the present time. The height of the lantern from the ground is just 2 feet to the centre of the flame. If the lantern is provided with a parliamentary spermaceti candle, it will, in the position I have stated, light a circle of 4 feet in diameter. The amount of light anywhere on the edge of this circle will be sufficient to enable a man with good eyes to read a leading article in *The Times* newspaper lying on the ground. This light will just enable a man to see his way before him as he walks. In a well-lighted neighbourhood, where the local authorities allow to each lamp 5 cubic feet of gas per hour, and there are no shops, it will be found that this is the average kind of light which is found at 7 feet 6 inches from the lamp-post. The lamp is 10 feet from the ground; but usually immediately under the lamp-post there is a kind of a dark gridiron-like shadow, about 8 feet across, with dark shadows going across the road, widening as they go. These shadows are the greatest possible hindrance to drivers, who cannot be sure if it is really a shadow in the road or a pedestrian.

So much are the lamps felt to be a hindrance rather than a benefit, that I believe if all the drivers were asked to vote on the question, they would vote almost unanimously for the entire suppression of the lanterns, if they could not have a light without shadow; but it would be a very different thing if the shadows were eliminated, and there, I think, is the first step to be taken in the improved light of the future.

An improvement which can be made in street lighting, at a very slight cost, is to put a reflector over the burner. This, I believe, was first successfully done by Mr. Woodall, the brother of your late President, at Burslem. He substituted a white porcelain top for the glass top usually seen in street lanterns, and although his example has found few imitators in England, it has been adopted in South America. All the lamps in Rio and Nictheroy are glazed with the Burslem porcelain tiles.

The next improvement is the abolition of the hideous and useless lantern cradle, which is mainly responsible for the troublesome shadows of which I have spoken. Next, if Argands are substituted for flat-flames, there will be an increase of at least 20 per cent. in the amount of light given. In France a great many chimneys are used with Argands in lamps. The railway station at Amiens has Argands only, with chimneys, all over the yards. In England objections are always made to the employment of chimneys; but I have been told by Mr. J. N. Douglass, the talented Engineer to the Trinity Lighthouse Board, that although they have in use perhaps the greatest number of chimneys of the large and small sizes, yet the amount of breakage, even with the rough weather to which they are often exposed, is so small as to be unworthy of consideration in their wear and tear accounts. Then comes the use of large burners on the crossings, at refuges; and, lastly, comes the use of 20, 50, and 80-candle burners in the most frequented streets.

The public desire larger lights, and if they do not get them with gas, then they will with electricity. It has been foretold more than once that electricity would vanish from the Avenue de l'Opéra, the Thames Embankment, and other places where it is used. These previsions have not been realized. The electric light has been adopted for at least one year in Paris, to light several important points in that city. Messrs. Keates and Bazalgette have declared in their report that it has established itself as a light for streets, and that it can reach a distance of 2½ miles from the central engine station. It is also stated that for lighting railway stations, large factories, shops, picture galleries, and the reading-room of the British Museum, above all things, it is the desideratum.

At the risk of being called a gas fanatic, of being told I am struggling to put the clock back, and of resisting improvement, I say I have proved to you that for street lighting gas is in every respect better than electricity. For large public halls it can be used with greater advantage in every respect, and without vitiating the air of those halls in any degree. For picture galleries the light is, when properly arranged, pure, white, and steady, and will not hurt the pictures nor vitiate the air. Nor will it increase the temperature of the room in which it is used. I have a small room, 14 feet square, lighted by a 100-candle Argand burner, which, burning for hours in ordinary weather, will not raise the temperature one degree. So for the British Museum gas might be used without shocking the susceptibilities of the fire insurance authorities, or endangering the books, and readers would be able to read in comfort, without danger to their sight.

Railway companies are adopting gas for their stations. The London and Brighton Company are about to light their Victoria and London Bridge stations with 80-candle burners, and the Great Northern Railway have already fixed some of these large burners on their platform at King's Cross. A large factory in Glasgow have resolved to try gas with 200 or rather 300-candle burners, for their erecting shops, and they will shortly be brought into use. They are also being used for markets, and the Authorities of the City of London are this moment trying experiments to see how the lighting of Queen Victoria Street will suit the celebrated market where the sanguine anticipations of Mr. Reed were falsified, and fresh fish looked like stale, and mackerel like whiting.

Gas lighting is a progressive science, and if electricity has been galvanized into renewed life by those very ingenious gentlemen and their associates, Messrs. Denayrouze and Jablochkoff, of whom you will have conserved a very pleasant recollection, so have we gas engineers received the *contre-coup* of the shock. We may fairly say that we are not behind in that race which will inevitably result in conferring on mankind one of the most cherished of blessings—more light.

The following tables accompanied the paper:—

[Table No. 1.]

Statistics of the Lighting of Queen Victoria Street and Waterloo Place, London, with Sugg's Large Burners and Lanterns.

Queen Victoria Street (common gas).

The lighting consists of—

Thirty 80-candle burners, each consuming 22 cubic feet = 660 feet, giving a total of	2400 candles.
Five 200-candle burners, each consuming 50 cubic feet = 250 feet, giving a total of	1000 candles.

Thus a light of 3400 candles is obtained from 910 feet of common gas (16-candle), which at 3s. 6d. per 1000 feet costs 38·22d. for the entire lighting per hour, or a light of 88·95 candles per one penny cost.

Waterloo Place (cannel gas).

The lighting consists of—

Two 200-candle burners, each consuming 45 feet = 90 feet, giving a total of	400 candles.
Forty-three 80-candle burners, each consuming 19 feet = 817 feet, giving a total of	3410 candles.

Thus a light of 3840 candles is obtained from 907 feet of cannel gas, which at 4s. 4d. per 1000 feet costs 3s. 11½d. per hour for the entire lighting, or a light of 81·4 candles per one penny cost.

[Table No. 2.]

Estimate of the Cost of 62 Electric Lamps on the Jablochkoff System in the Avenue de l'Opéra, burning from sunset till midnight, each lamp giving a light equal to 115 spermaceti candles (burning 120 grains of material per hour) in an oblique line from the lamp to the ground, and from 170 to 190 candles in a horizontal direction from the lamp. The lamps are enclosed in an albatrine shade.

Capital Account.

Two steam-engines like those on the Thames Embankment at Westminster—viz., 20-horse power nominal double-cylinder engines, capable of working up to 90-horse power, at £400 each.	£800	0	0
Three Gramme double machines, at £400 each	1200	0	0
Fixing counter-shafting and laying the wires in the streets, foundation of engines and machines (calculated from the cost given by Lt.-Col. Haywood for the Holborn Viaduct experiment)	600	0	0
Sixty-two Jablochkoff lamps and carbon-holders, with commutators, at £10 each	620	0	0
Leading wires, with return current and commutators, fixed, 15,000 yards	1200	0	0
Total	£4420	0	0

Lamp-columns same as used by the Gas Company	—		
Interest on £4420, at 4 per cent., for one year	£176	16	0
Wear and tear on engines, machines, counter-shafting, &c., for one year	260	0	0
Wear, tear, and maintenance of globes, lamps, &c., at 15 per cent.	93	0	0
Wear and tear of leading wires and commutators, at 5 per cent.	60	0	0
Total	£589	16	0
	Per Hour.		
£589 16s. divided by the number of hours in a year from sunset to midnight, 2073 hours	£0	5	8¼
Motive force, carbons, attendance, as per M. Lévy's estimate (*vide* M. Cernesson's report to the Paris Municipal Council, *ante* p. 90)	0	0	7½
Total cost per lamp	0	6	3¾
Total cost of the 62 lamps	£19	11	4½

To this must be added the cost of gas from midnight to sunrise required to replace the electric lamps, which are all extinguished at midnight, or 5s. 9d. for every hour for a total of 344 gas-burners.

Discussion.

Mr. F. W. Hartley (London) complimented Mr. Sugg on contributing a very valuable paper to the proceedings of the Association. With respect to Dr. Siemens's statements before the House of Commons Committee on Lighting by Electricity, as to the quantity of gas produced from coal and its lighting value, Mr. Sugg and himself had noticed the discrepancies at the same moment. The cost of the electric lights at the Albert Hall was said to be 12s. 6d. an hour, against about 22s. for gas which thoroughly lighted the hall; but it would be easy, by the employment of large Argand burners, to produce by gas as much light as was at present produced by electricity, for something like 12s. 3d., instead of £1 2s. He (Mr. Hartley) was sorry that Mr. Sugg had confined himself so much to the Jablochkoff system, because there were other important methods, and there was a perfect agreement between Dr. Tyndall, Dr. Siemens, Mr. Cooke, and Mr. Preece that, for electric lighting to be economical, large lights must be used, and not small ones. Those gentlemen asserted that electric lights of 1000-candle power each could be produced economically; but arguments in favour of such electric lights broke down when it was considered how those large lights were to be applied. According to Dr. Siemens, they were to be something like 100 yards apart. Streets could be well lighted, under the ordinary gas system, by lamps placed 40 yards apart, for a length of about 14 miles for £1 2s. an hour for gas, while it would require, in order to produce the effect which Dr. Siemens deemed to be necessary, something like 38 of his big electric lights. Without going into any discussion of the possible cost of engines, dynamo machines, conductors, carbons, labour, &c., it would be seen that the "big light" scheme was impracticable; hence they were driven back to the position which Mr. Keates took up—viz., that electric lights for the streets must be comparatively small lights, spaced at short distances. His evidence went to show that as much light could be obtained for 2d. with gas as for 5¾d. by the Jablochkoff system. With gas at 3s. 4d. per 1000 cubic feet, it cost, for 5-feet burners, two-tenths of a penny each per hour. Twopence was therefore ten times the present cost. Mr. Sugg said that the public demanded big lights, and would have them. The public might desire big lights, but what would they say if they had to pay ten times the present charge for street lighting? He might cite one parish in London which was now paying £4000 a year for gas alone, which, multiplied by ten, gave £40,000. What would the ratepayers say to that? Yet this was cheap as compared with the possible cost of lighting the same streets by the agency of Jablochkoff candles, which now cost 29 times as much as ordinary gas lighting, and would bring the charge up to £116,000 a year, instead of about £5600, the present cost for gas, lighting, cleaning, &c. The absurdity of the thing appeared at once on the face of it, for no parish would be taxed to such an extent, or even to the half of it. Were it possible to space the lights more widely apart, Mr. Sugg said he could light streets effectively for three times the ordinary cost, and he (Mr. Hartley) was quite prepared to believe this; still, three times £4000 amounted to £12,000, while maintenance would be more costly, and he questioned whether a parish would accept such a rating. This was an argument absolutely in favour of gas lighting. If the public wanted large lights they must pay for them; but the moment the charge was put upon them he believed they would recoil from it. Coming to the question of the application of the electric light to large areas, he said emphatically there must be one system of lighting, and the best system was by large gas-burners. There could not be two discordant and antagonistic lights which spoiled each other. Again, as to the actinic effect, he believed it would be found by-and-by in warehouses, that the colours of cloths and other fabrics would be seriously affected by that quality. He would not say much upon the subject of the production of nitrous oxide, because it was not large in quantity, and it was scarcely necessary to raise that as an objection. An objection which had been raised to gas lighting was that it produced great heat, and vitiated the atmosphere. Although he was not at liberty to say much about it at present, he might mention that he had a few days previously seen a burner for which it was claimed that it evolved a greater amount of light than any other burner, and yet the heat was considerably diminished. He had only seen it experimentally, but the burner delivered its products at so low a temperature as to be perfectly startling, whilst the value of the light was increased, and the apartment was maintained much lower in temperature than usual. There was, therefore, a large field left open for improvement in the application of gas, though electricians seemed to assume that gas lighting had reached its maturity, while, in fact, it was only progressing to a higher state of development, and at the same time becoming cheaper. They had had as witnesses before the Committee of the House of Commons, Dr. Tyndall and Dr. Siemens, who spoke with positiveness as to the necessity, for economy's sake, of having large electric lights; whilst the Engineers of the Société Générale d'Electricité asserted that they could do as well with their small lights as those eminent electricians said was posssible only with big ones. Not only that, but they sought, as it appeared to him, to impress the Committee of the House of Commons with the notion that they could generate force enough for twice or three times the number of lights they were then working, with the same expenditure of fuel, or without increase of engine power.

Mr. W. Cleland (Linacre, Liverpool) said he had been in hopes there would have been something said on a point which must be extremely interesting to members generally, as it was to himself. They had heard a great deal of the probable result of the contest between gas and electricity, and much was said about improved lamps, the extended distance to which the electric current could be sent, &c. But the fundamental point, upon the practicability or impracticability of which would depend

the issue of this contest, was one that had not been touched upon—namely, the possibility of dividing the light without a serious loss of illuminating power. It seemed to him very extraordinary that there should at this time be such a wide divergence of opinion on that subject. They had Dr. Siemens, in his evidence before the Select Committee of the House of Commons on Lighting by Electricity, positively asserting that the loss of illuminating power through division was as the square of the number of divisions; others asserted it was as the cube. On the other hand, Sir William Thomson as positively maintained it was all a mistake, and that the light could be divided practically without loss of illuminating power. It seemed to him (Mr. Cleland) this was a question, as compared to which all others were mere detail. If Sir William Thomson were right, he thought their industry was in some danger; but, if the others were right, then serious rivalry from the electric light was far off indeed. If an electric light equal to 1000 candles was divided into 10, and there were obtained not ten 100-candle lights, but ten lights of 10 candles—or still worse, ten lights of 1 candle—then the difference between the possibilities of the electric light and the practicabilities of gas were so vast that gas companies had nothing to fear. This was the point which he thought really ought to be determined, and possibly there were some members sufficiently versed in electricity to be able to decide it. It could not be so exceedingly difficult to take any given electric light, and by dividing it into any given number, ascertain the relative power of the divided lights, for it was the relative power only which it was now so important to determine.

Mr. J. Chapman (Harrow) said he was one of those who went to see Mr. Werdermann's light. It was divided into ten lights, and each one was said to have 40-candle power; but, for his part, he could not compare it to anything more than a good-sized rushlight. The room could not have been more than 30 feet by 12 or 13 feet, and yet the light was not so glaring as to prevent some young ladies and gentlemen, in a corner, carrying on a *tête-à-tête* in perfect shade. When he was told the number of candles this light represented, it was to him a very astounding fact. One of the most experienced men in the gas world was with him, and he agreed with him on this point; in fact, one could hardly see what colour the walls of the room were, and he thought there must be several kinds of photometry, one for gas lights and another for electricity. He should like to ask if any one knew whether Sir William Thomson had published his plans of how he was going to put the water-wheel over Niagara to light up the northern part of America, because that was the sort of thing that was talked about, and he thought perhaps the plans might be out, and some one might have seen them.

The Secretary drew attention to some interesting experiments recently made at Rheims by the Engineer and Manager of the Gas Company, and published by the Société Technique de l'Industrie du Gaz en France, with regard to the great loss of illuminating power by division of the electric current. He said that reckoning the illuminaiing power of the naked voltaic arc from a Serrin regulator at 290 Carcel lamps, it was found that by the interposition of an opal globe, there was a loss of 92 Carcels, or 31·72 per cent.; by the use of one of Regnier's lamps the loss was 132 Carcels, or 45·51 per cent.; by the interposition of two lamps, 203 Carcels, or 70 per cent.; by the interposition of three lamps, 253 Carcels, or 87·24 per cent.; and by the interposition of four lamps the light ceased entirely. He (the Secretary) commended the attention of gas engineers to these experiments, which were most elaborate, and appeared to have been made with the greatest care. They embraced many trials with the view of ascertaining the illuminating power of both the electric light and various kinds of powerful gas-burners, and an examination of them would well repay the time spent in the perusal of the report.

Mr. D. Bruce Peebles (Edinburgh) said it was very evident from the paper just read that the case between gas and electricity would be well fought out, and that if it ever came to such a pass as that the one was fighting against the other for a bare existence, gas would at any rate die game. He believed that so long as a plentiful supply of coal was to be had, gas would easily hold its own; but, at the same time, no good warrior ever under-rated the power of his enemy, and they should freely admit that electric lighting had made some rapid strides lately. While, therefore, it was quite evident that, in the present state of affairs, gas had entirely the upper hand, they did not know what a day might bring forth, or how soon electricity might go forward with a bound. No one who had read the life of George Stephenson could help remembering the answer he gave to a question when giving evidence about railway matters before Parliament: "Supposing a train, going at this extraordinary rate of 20 miles an hour you speak of, was to come against a cow, would not that be very bad?" He replied, "Aye, very bad for the coo." Now 50 and even 60 miles an hour were run at the present day, and little thought of it. It was not impossible, but rather very probable, that electric lighting might make quite as great a stride forward, and they should never lose sight of such a possibility, but rather try and be prepared to meet it. A few days ago he received a newspaper from New York by which he saw that the American gas engineers were taking that view, and had started a society for the purpose of considering what would be the best means of upholding the power of gas against electricity. It was quite apart from the American Gaslight Association, and its objects seemed to be entirely limited to fighting this battle (if it might be so called) of gas against electricity, not altogether in an unfriendly spirit, but by acknowledging that electric lighting was no longer a thing of the past, and must be met by employing the best methods, and most economical processes of manufacturing gas, so that they might be able to meet electricity on all points where it would be likely to encroach on the field now occupied by gas. His own opinion, he might again state, was, that so long as there was coal in abundance, there would be no fear of gas, for even if it were not used as an illuminant, it would be more and more used as a source of heat and motive power, and manufactured on account of the bye-products which had now become so valuable in the arts and manufactures. In such a case their value would certainly increase, and, along with these, other sources of income might likely make the distillation of coal quite as profitable as it now was. He also understood that an English Electric Light Company had gone to New York, and was there working successfully against Mr. Edison. With regard to Sir William Thomson's opinions, it was whispered that he and Professor Tait had been very much together for some time past, and it was thought Sir William must have discovered something new, which had enabled him lately to give such distinct and decided evidence regarding the electric light.

Mr. G. B. Irons (Gosport) said, as gas managers, they knew that there was great loss of light by distribution through small instead of large burners. This they had seen in the large lights of Mr. Sugg, as compared with the old ones—especially the little jets some would persist in using, particularly in churches. They knew that the amount of light was less when the lighting body was distributed in small quantities, whatever was the source of light. As to the question whether the loss by division of the electric light was in the proportion of the squares or cubes of the numbers, as stated by Mr. Preece in his evidence before the Commons Committee, it might very well be left to the more experienced electricians to determine; but the loss of light by division was a natural law they could not get over. As most of them had read, the new iron turret-ships in the Royal Navy were fitted with electric lights generated by Gramme or Holmes machines driven by one of the many engines on board; and he was himself able to read when the light was nearly three miles off; but this was the concentrated and reflected light from a very powerful machine costing about £700. There was no question that the shadows thrown by old-fashioned street-lamps were very objectionable, and when such lamps were introduced into a new district, many coachmen had said they would rather be without the light at all, because the shadows thrown across the road were confusing to them, and they could hardly pick their way.

Mr. J. Paterson (Warrington) desired to express his thanks to Mr. Sugg for the very able, comprehensive, and exhaustive paper he had read. It was one more fit for study than for commenting upon without consideration; but it appeared evident that, light for light, gas had nothing to fear from its competition with electricity, and he thought the supporters and exponents of the electric light did injustice to themselves in placing it in such a position as to compete with coal gas. There were, no doubt, many ways in which the electric light might be made exceedingly valuable, apart altogether from any competition with gas, and it was quite possible that the time might come when, by a more perfect system, and adaptation of means to ends, its relative value might be improved; but so long as the electric light was obtained by the conversion of mechanical energy into electricity and light, it could never be an economical mode of illumination. There were, however, other elements which were very much against its permanent introduction as a constant light; for example, the rapid destruction of the carbon electrodes. So long as the electric light depended on these charcoal points, it was really impossible to have a steady, constant light. He thought there was no doubt that the amount of light was reduced in a geometrical ratio by the division of the current. Practically, to all intents and purposes, this fact destroyed the power of utilizing the light, because although it might be done, it could not be done profitably, and no human agency could overthrow the laws of nature. But while acknowledging this fact, it should not be the wish of gas managers to disparage nor in any way detract from the merits of the electric light, which had already done good service to the profession, by stimulating to improved methods in the combustion of gas.

Mr. H. Woodall (Leeds) said although gas had nothing to fear from the competition of electricity, still it behoved them all to see how gas could be improved. It seemed to him very plain that it would be to their advantage to offer some inducement to local authorities to increase the quantity of gas consumed in their lamps. They all knew that if they had more gas to make they could make it more cheaply, and, therefore, he should be disposed to offer public authorities, in consideration of their increasing the quantity of gas consumed, that for the increased quantity a reduced price should be charged. If they could increase the quantity of gas made by 100 per cent., the amount required to pay interest on capital would be considerably reduced. Supposing it now cost 1s. per 1000 feet to pay dividend, the increase in works that would make double the quantity would not cost, generally speaking, much over 6d. per 1000 feet, so that it would be to their advantage to make a reduction by anticipation. It was a difficult thing, he could see, to charge different rates to different consumers; but between public authorities and the general public, a very distinct line could be drawn, and it would be very simple to make contracts with the authorities that for a certain consumption the price should be so much, but if it were below that amount the price should be the same as that charged to private consumers.

Mr. J. R. Frith (Runcorn) said they had had two lectures on the electric light at Runcorn, and for one of these he obtained a Wigham and a Sugg burner, and after the lecture every one was convinced that gas would be superior. He had these burners carefully tested, and he could bear out Mr. King's statement in the Journal of Gas Lighting, of April 22, that the Sugg burner, with the three concentric rings, gave an illuminating power of nearly 5·2 candles per cubic foot. He had also one of Wigham's burners purporting to give 400-candle light; but on trying it he found it would only give a light of a little under 4 candles per cubic foot, so that really the Sugg burner had the advantage over it by more than one candle per cubic foot. They were indebted to Mr. Sugg for the great interest he had taken in this question. He had been their champion in this cause, and had rendered valuable service to the whole of the gas world.

Mr. W. Romans (Sheffield) said they had at Sheffield tried the electric light, and now they were trying Mr. Sugg's burners. With these they could read a newspaper midway between the lamps; but with the electric light they could not read at all—he could not read his own name on his card. The very cabmen could not see their horse's heads. He hoped the Corporation of Sheffield would decide on adopting the Sugg burners.

Mr. Corbet Woodall (London) thought the time had really come when the figures as to the cost and value of the electric light given by its promoters ought to be answered, and therefore he sympathized in that direction with the character of Mr. Sugg's paper. At the same time he thought it would be wise to abstain from sneering at the electric light. The progress made with it was eminently creditable to those who were working at it, and there was room doubtless for considerable application of it without the smallest loss to gas companies. The trial on the Thames Embankment had shown that with good apparatus in careful hands the electric light could be made a practical light, and the question of its application in such situations was reduced to one of labour and cost. While there had been a large number of extinctions in the streets of Paris, he believed that, during the many months that the lights had now been burning on the Thames Embankment, there had been but one extinction. In many ways they were indebted to the interest which had been excited by the electric light. He had not one particle of fear as to its injuring the gas interest, for he felt convinced that both in the matter of adaptability and of cost there was no fear of its entering into serious competition. That feeling was based upon these facts: Nothing whatever had been done which elevated it out of the category of lamps requiring the attention of the consumer, and needing serious and frequent attention. That being so, there was a decided difference between it and gas lighting, which no question, even of economy, could absolutely overcome. Again, there had been found no way of producing lights of less than 200 or 300 candles power, except at vastly increased cost, and, consequently, the number of its applications was limited. Further, there could be no reserve of light at once available, as was the case with gas; and the light for ordinary purposes was a most unpleasant one even when momentarily steady. As to street lighting, he owed some gratitude to Mr. Sugg for upholding his (Mr. Woodall's) reputation as a prophet. He remembered last year saying that if the public authorities would agree that it was desirable to increase the amount of illumination, they (the gas managers) had only to turn to Mr. Sugg, and he would bring out yet another burner which would do all that was required. His own experience in this matter was entirely satisfactory. After witnessing what had been done in Paris, he suggested to his Directors that it would be the right thing to show what could be done with gas, if people were prepared to spend the necessary money. Accordingly they lighted, by means of improved lamps, a strip of road in their district very well indeed, and the result had been that to a large extent the new system had been adopted by the Vestries. That example had since been copied by many neighbouring parishes, and generally it had resulted in a large increase in rental of the Company. He

thought it was very doubtful whether it was economical to use large burners at considerable distances, instead of small burners close together. In the Waterloo Road he put up lamps at frequent intervals, abolishing the objectionable basket which caused the shadows, added reflecting tops, and increased the consumption of gas to 6 instead of 5 feet per hour. The general effect of the light was exceedingly pretty, effective, and cheap. When they remembered the ordinary charge made for gas lighting, it would be seen that there was room for a considerable increase in the expenditure, and yet keep far within anything the electric light could do. For instance, in that particular road, the lighting was effected at a cost of under 20d. per mile per hour, including gas, lighting, repairs, and maintenance. Contrasting that with the electric light, it would be seen what a very large margin there was for increased expenditure, if it was called for. He entirely agreed with Mr. Hartley, however, that the ratepayers would not stand the increased cost involved by some of the systems which had been shown. He believed the lighting of the streets generally was sufficient at the present time. In great thoroughfares, where there was much traffic, it was most desirable largely to increase it, especially at centres of traffic; but as far as the general illumination of the streets was concerned, he thought it was at present sufficient, and any large increase in the rates of a town or parish, called for in order to increase largely the general lighting, would be met with strenuous opposition.

Mr. Sugg, in reply, said his paper had been so kindly received that there was very little he need refer to, except the remark of Mr. Woodall as to the cost. If the public bodies would not spend any more money in lighting the streets than they now did, it was perfectly clear that they would not have anything to do with electricity. He had addressed himself to what could be done by gas as compared with electricity; but if the public were determined they would not spend any more money, there was an end of it. What he had also pointed out was that, even with the number of feet of gas at present consumed, it would be possible to give more light by the use of improved burners, and more effective illumination by abolishing the shadows. He was quite sure, however, that there would eventually be an increase in the consumption of gas in the public streets. Of course, it would not come all at once; no public improvement ever did. First the crossings would be improved, and then other places would by degrees receive attention.

[The other papers read will follow in due course.]

ROCHDALE CORPORATION GAS-WORKS.

Annual Report of the Gas Committee.

At the Monthly Meeting of the Rochdale Town Council, on Thursday, the 5th inst., the following report of the Gas Committee, for the year ending March 25 last, was presented:—

Your Committee are again sorry to state that there has been a decrease in the consumption of gas during the past year of over half a million cubic feet, although there is an addition of nearly 400 to the list of consumers.

The surplus profits this year amounted to £8765 10s. 3d., but your Committee considered it advisable to charge the cost of new station-meter to revenue, thereby reducing the profits to £8018 17s. 7d.

It will be seen that the amount received for public lamps is about £600 less than last year. This is owing to a reduction having been made in the amount charged for each lamp per annum.

During the year the new station governors have been working. Each governor supplies a separate district, and it is satisfactory to state that the pressure is now much more, even over the whole area of consumption, than it was possible to attain with one governor, and the percentage of loss by leakage this year (although many mains were broken during the long-continued frost) is less, with one exception, than any year recorded.

Your Committee have also to state that the large new station-meter erected last summer, and capable of registering 80,000 cubic feet of gas per hour, is giving every satisfaction. Taking the combined measuring capacity of both meters, they are equal to register correctly nearly 3 millions per day.

The following summary represents a comparative view of the working for the year ending March 25, 1879, and March 25, 1878, viz.:—Gas made this year, 244,738,000 cubic feet; gas made last year, station-meter registered incorrectly; gas sold this year, 218,938,000 feet; gas sold last year, 219,577,000; decrease, 639,000 feet. Value of gas sold, after deducting discounts, this year, £42,686 3s. 11½d.; value of gas sold, after deducting discounts, last year, £43,297 15s. 11½d.; decrease, £611 12s. The profits this year amount to £8018 17s. 7d.; the profits last year amounted to £8622 9s. 2½d.; decrease, £603 11s. 7½d. The present number of consumers, 15,645; number of consumers last year, 15,267; increase, 378; new lamp services laid this year, 8; making total new consumers and lamp services, 386. 2688 yards of new and additional main-pipes have been laid during the past year in various roads and streets, at a cost of £763 14s. 9d.; the services referred to above cost £222 14s. 6d.; extensions on the works during the year, £2687 11s. 4½d.; making total chargeable to capital, £3674 0s. 7½d.

Dr.—*Profit and Loss Account from March 25, 1878, to March 25, 1879.*

To Gas rental, general account		£40,283 2 4	
Public lamps, including lighting, extinguishing, cleaning, and repairs		4,369 1 8	
Public lamps—Castleton Local Board		135 8 6	
Do. Wuerdle and Wardle do.		47 2 7½	
Sundry accounts		35 19 0	
		£3,017 11 2	£44,870 14 1½
Tar and ammoniacal liquor		2,507 14 8	
Coke		57 5 0	
Fitting trade		22 15 0	
Cottage rents			5,605 5 10
			£50,475 19 11½

Cr.—*Profit and Loss Account.*

By Carbonization—			
Stokers wages		£2,855 0 8½	
Coal and cannel used	£16,385 2 8		
Horse and cart work	703 0 5½		
Men's wages, unloading, and stacking	272 7 7		
		17,360 10 8½	£20,215 11 5
Purification—			
Wages		£334 14 3	
Lime, &c.		132 12 9	
Oxide of iron		120 0 6	
		£587 7 6	
Less spent oxide and lime sold		86 10 0	
			500 17 6
Yard labour—			
Wages		£464 13 8	
Cartage		109 0 0	
			573 13 8
Wear and tear, retorts—			
Wages		£483 12 0½	
Retorts, &c.		677 17 6	
Castings		597 0 10	
Cartage		27 12 6	
		£1,786 2 10½	
Less materials sold		10 15 0	
			1,775 7 10½
Carried forward			£23,065 10 5½

Brought forward			£23,065 10 5½
Wear and tear, works, and tools—			
Wages	£723 13 11½		
Ironwork	382 19 0½		
Joiners, slaters, and masons	216 19 4		
Oil, paint, and cement	153 4 0		
Hemp waste and lead	33 8 3		
Water-rent	40 17 9		
Cartage	11 6 6		
Sundries	48 8 8		
Paving	16 19 4		
Station-meter	746 12 8		
	£2,374 9 6		
Less old iron, &c., sold	40 6 1		
		2,334 3 5	
Wear and tear, mains and services—			
Wages	£302 9 1		
Pipes and castings	317 13 4		
Sundry materials	82 17 9		
Lead	41 5 0		
Cartage	31 2 6		
Paving	128 13 7		
	£904 1 3		
Less materials used, &c.	170 5 3		
		733 16 0	
Meter inspection, wages		588 5 7	
Salaries and office expenses—			
Salaries	£1,062 12 0		
Auditing	15 0 0		
Printing, stationery, stamps, &c.	144 8 1		
		1,222 0 1	
Miscellaneous expenses—			
Travelling expenses	£5 15 8		
Commission per bank	55 0 0		
Advertisements	63 0 4		
Compensation	7 17 6		
Meter-books	10 0 0		
Sundries	4 10 10		
	£146 4 4		
Less meter-books sold	3 15 0		
		142 9 4	
Wear and tear, lamps—			
Wages	£810 18 8		
Repairs and materials	119 3 0		
	£930 1 8		
Less materials sold	15 6 0		
		914 15 8	
Rent of land	£160 6 11		
Rent, rates, and taxes	1,346 4 1		
		1,506 11 0	
Discounts on gas-rental	£2,184 10 2		
Bad debts, estimated	80 0 0		
		2,264 10 2	
Interest on loan account	£7,291 17 0		
1-75th part of mortgage debt to sinking-fund	2,393 3 8		
		9,685 0 8	
Balance, being profits		8,018 17 7	
			£50,475 19 11½

Dr.—*Balance-Sheet.*

Assets.

To Value of works, per last year's balance-sheet		£163,871 14 9	
Less amount allowed for depreciation, being 1-75th part of debt	£2,393 3 8		
Less per General Purposes Committee for altering level of street	1,640 0 0		
		4,033 3 8	
			£159,858 11 1
Amount expended from March 25, 1878—			
Mains		£763 14 9	
New services		222 14 6	
New governors, governor-house, offices, &c.		2,320 13 4½	
New lamp services		2 16 6	
Boundary wall, &c.		137 8 0	
Horses and carts		226 13 6	
			3,674 0 7½
Present value of works			£163,532 11 8½
Amounts due—			
Gas-rental		£12,892 1 1½	
Public lamps rental		4,309 1 8	
Public lamps, Castleton Local Board		74 11 6	
Public lamps, Wuerdle and Wardle Local Board		19 11 10	
Sundries ledger		1,687 2 2	
Fittings ledger		77 8 10	
			19,119 17 1½
Stocks, as per details in stock-book—			
Coal and cannel		£890 5 6	
Main-pipes		867 6 7	
Fitting trade		529 6 3	
Wear and tear, mains, &c.		513 9 10	
Oxide of iron		191 5 0	
			2,991 12 8
Balance in Manchester and Liverpool District Banking Company			1,498 18 6
			£187,123 0 0

Cr.—*Balance-Sheet.*

Liabilities.

By Mortgage debt, as per last year's balance-sheet		£169,742 16 7	
Amount borrowed from depreciation-fund		9,063 2 11	
		£178,805 19 6	
Less 1-75th part of debt paid over to the Finance Committee for sinking-fund		2,393 3 8	
			£176,412 15 10
Debts owing on trade account			2,370 19 9
Bad debts on gas-rental			310 14 3½
Deposits, being amount paid in advance for gas			9 12 6
Balance from last year			0 0 0½
Balance, as per profit and loss account			8,018 17 7
			£187,123 0 0

Dr.—*Capital Account.*

To Amount paid late Gas Company, and expenses incident to purchase			£27,700 0 0
Extension of gas-works, 1845 to 1878			176,778 18 2
Extension of gas-works, 1879			3,674 0 7½
Balance			6,260 4 1½
			£214,413 2 11

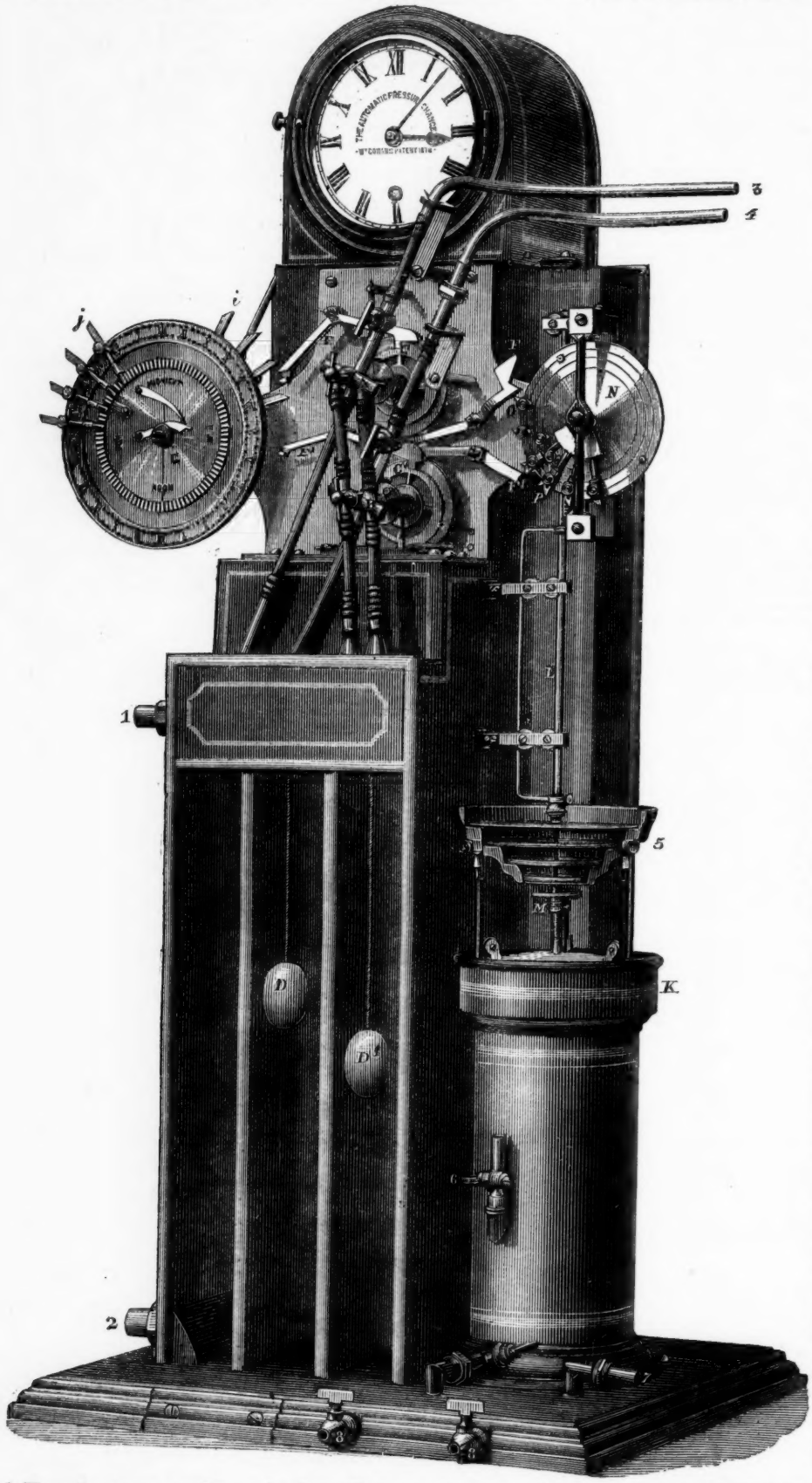
Cr.—*Capital Account.*

By Amount borrowed from Hand in Hand Assurance Society, 1844			£27,700 0 0
Amount borrowed from depreciation-fund, 1845		£464 17 1	
Amount borrowed from various persons, 1846		1,750 0 0	
Amount borrowed from depreciation-fund, 1853		8,593 5 10	
		9,063 2 11	
Amount borrowed from various persons, 1853 to 1864			36,900 0 0
Amount borrowed from Finance Committee, 1866 to 1878			139,000 0 0
			£214,413 2 11

COWAN'S AUTOMATIC PRESSURE CHANGER.

As reported in another column, at the meeting of the British Association of Gas Managers, Mr. W. Cowan, of Edinburgh, read a paper entitled "The Automatic Pressure Changer," in which he described his recent invention. We here give an illustration, and full description of the manner of working the apparatus.

The keys or plugs of the two taps A B are each fixed to, and revolve with the axis of a pulley C C^1, which, by a descending weight D D^1, is moved round a quarter of a revolution every time the double levers E E^1 are moved out of any one of the four catches by which each pulley is successively held, and its tap retained, alternately, in the open or closed positions. The taps A B have each two separate passages, for water and gas (or air) respectively. These passages open and close together. It is, therefore, only when water is running into, or out of the tank on governor bell, that gas (or air) can pass from the governor to the small gasholder K. The apparatus is, therefore, only in open connection with the governor during the periods while pressure is being changed. The object of this arrangement will appear further on.



1. Water Connection from Cistern.
2. Water Discharge to Drain.
3. Water Supply to Governor.
4. Syphon Pipe from Governor.
5. Basket Supports for Weights.
6. Water Line Tap.
7. Connection for Gas-Pipe from Governor Outlet.
8. Clearing Taps.

The clock disc G carries round the tappets *i, i, i, i*, and *j, j, j, j*, by which the levers E E^1 are moved out of the catches, and the taps so opened. The tappets *i, i, i, i*, act to *raise* the pressure, by causing the tap A to be opened, which supplies water to load the governor. The tappets *j, j, j, j*, act to *reduce* the pressure, by causing the opening of the tap B, through which water is withdrawn by means of a syphon, and the governor unloaded.

The loading, or unloading, of the governor, consequent on the opening of the water supply or withdrawal taps, is followed by a gradual increase, or decrease, of the gas (or air) pressure within the bell of the gasholder K, which has a pipe led into it from the governor. This pipe divides into two branches, near the taps, one branch leading to the gas (or air) passage of the tap A, and another to that of the tap B. These branches, beyond the taps, are united again into one pipe.

The bell, in rising or falling, carries up or down the vertical rod L, upon which is a rack geared into a toothed wheel, fixed on the axis of the disc N. Upon this disc are the tappets *o, o, o, o*, acting successively upon the lever F (as the bell ascends) to close the supply tap, and so stop the increase of pressure when the desired points have been attained. And on this disc also are the tappets *p, p, p, p*, which act in succession upon the lever F^1 (as the bell descends), and so to shut the withdrawal tap in like manner.

To prevent the bell of the gasholder rising, as it would do, to its utmost limit, under the minimum pressure necessary to raise it, there are a series of weights, resting upon supports, equally distant from each other, but each succeeding rest and weight further from the small plate, or table, M (on the vertical rod L), which carries the weights up as the bell ascends. By this means a certain pressure (depending upon the amount of the weight) lifts the first weight, and, about the same time, causes the corresponding tappet, on the disc N, to raise the tail of the lever F, and so allows the pulley C to close the tap A and stop the increase of pressure. When the clock has again acted to open the tap, the gasholder again closes it by rising, when the pressure is high enough to lift the second weight, and so causes the next tappet to act on the lever F. And so on, as often as may be necessary, and according to the number of tappets provided, and set for action, on the disc. In like manner, when the clock has opened the tap B for reducing the load and pressure, the bell will descend, till it deposits upon the support the weight it last took up (when ascending), and about the same time the corresponding tappet on the disc N will depress the tail of the lever F^1, and allow the pulley C^1 to close the tap B^1, and so stop any further decrease of pressure. When the clock again opens the withdrawal tap, the gasholder will (when the desired result is attained) close it by falling till the deposit of the next weight, and the action of the corresponding tappet (on the lever F^1) stops its further descent, and the reduction of the pressure, and so on, till the minimum is reached.

Thus, *the clock initiates the work to be done; the gasholder, acting under the influence of the gas (or air) pressure, determines when it is done.* This ensures an accuracy as to time and degree otherwise unattainable. Further, as the personal attention is reduced to the weekly winding of the clock and catch-pulleys, the saving effected by sub-

stituting "The Automatic Pressure Changer" for the present system must be considerable, and especially so where the governor is placed at some distance from the works. In such cases, a further saving (of gas) may be effected by the pressure being reduced automatically; at times it has hitherto been found inconvenient and expensive to do it by hand.

During dark or foggy weather, it might be necessary to put on pressure at earlier or different hours than those for which the tappets might be set. The machine will allow this to be done without any derangement of its functions. The governor may be loaded by other means, and the Changer remain unaffected. This result is due to the peculiar construction of the taps, as before mentioned.

No gas (or air) entering the holder unless water is at the same time being supplied or withdrawn from the governor, no change will occur in the relative positions of the tappets on the gasholder disc, in the event of the pressure being increased or diminished by means other than the Changer. In fact, the machine, like the man who at present loads the governor, practically leaves it till its services are again called for, when the fixed time arrives. Thus, it is as practicable to load independently of it in the intervals, as it is, under the present system, for any one to change the pressure in the absence of the usual attendant.

The pressure being changed automatically, the usual check of a pressure register may by many be thought unnecessary, and by such be dispensed with. But, when desired, a pressure register may be combined with the Changer, both being actuated by the same clock.

Clevedon Gas Company.—The annual general meeting of this Company was held on Monday, the 6th inst.—Mr. J. Maynard in the chair—when the following report was adopted:—"Your Directors have to report a continued increase in the business of the Company. During the past year the price of gas has been reduced from 5s. to 4s. 7d. per 1000 feet. The public lamps have also been reduced, but with this reduction the balance of profits to the 31st of March is still in excess of last year, and we propose paying the same dividend (8 per cent. on A, and 7 per cent. on B shares), carrying £100 to depreciation." It was stated that the increased consumption had compensated for the reduction referred to in the report, and in commenting upon the revenue receipts for gas for the year ending March 31, 1879, which amounted to £2716 9s. 8d., the meeting was congratulated upon the growth of the Company's business since 1871, when the receipts for gas amounted to only £1562 9s. 10d.

Gas for Fog-Signalling.—A new means of employing gas for the purpose of fog-signalling at lighthouses has recently been devised by Mr. J. R. Wigham, of Dublin. The instrument used is of the siren type, but much more powerful than those usually employed. The machinery for admitting and cutting off the motive power by which the siren is actuated is of novel but very simple construction. The most important part of the invention, however, consists in the fact that the signal can be sounded at a moment's notice on the appearance of fog, without the necessity existing in other apparatus for wasting time in getting up steam, or raising heat, during which interval, owing to the great speed at which steamers now travel, valuable lives and property might be sacrificed. The sound is of so powerful and penetrating a character that it produces distinct and continuous echoes along a coast line opposite to the position in which the instrument is placed, and a distance of six or seven miles from the instrument.

Napier (New Zealand) Gas Company, Limited.—The fifth annual meeting of this Company was held on Tuesday, the 25th of March last, when the Directors submitted their report for the year ending the 31st of January, which stated that a profit of £1285 15s. 2d. had resulted from the operations of the Company during the year. Debts owing from the commencement of the business to the end of the year, amounting to £106 8s. 5d., had been struck off as bad, thereby reducing the profit to £1179 6s. 9d., which amount, with the balance from last account, showed a total to credit of profit and loss account of £1323 10s. 10d. A large increase in the revenue had been derived from the consumption of gas. This had resulted from the extension of the mains, as stated in last report. Forty-nine new services had been laid on during the year. The new tank and holder, of the capacity of 19,000 feet, had been erected, at a cost of £1360, and was in use. Owing to the large overdraft at the bank, the Directors did not feel themselves justified in recommending the payment of a dividend. If such a course had been deemed advisable, it would have been necessary to make a further call, which at present they did not think would meet with the approval of a majority of the Shareholders. The income of the present year would reduce the overdraft; and, as no extraordinary expenditure would be required on the works, it was probable that a dividend would be declared at the next annual meeting. Owing to the resignation, through pressure of private business, of Mr. Alexander Kennedy of his position as Secretary of the Company, the Directors had appointed Mr. J. B. Fielder to that office. It was found necessary to make a change in the managership of the Company, and the services of Mr. Charles H. Edwards, late of the Sydney Gas-Works, had been secured, which change, it was hoped, would prove advantageous to the interests of Company.

Gas v. Electricity for Harbour Lighting.—The comparative merits of gas and electricity for the lighting of harbours are now being tried on a rather extensive scale at Havre. Several improved gas-lights and electric lamps have been erected upon the quays of the outer port and upon the north jetty, with the view of testing the suitability and cost of each system, and it will be seen from the following figures, which are quoted from *Le Gaz*, that the advantage is considerably on the side of gas. The electric lamps at present fixed are placed about 33 yards apart, and, supposing this distance to be found suitable, it is estimated that some 60 lamps in all would be required for the lighting of the outer port and jetties. For supplying these lamps, three dynamo-electric machines at least would be required, exclusive of reserve force, which ought to be provided to guard against accident. These machines, with the necessary conductors, commutators, lamp-pillars, &c., are estimated to cost £4600. The motive power required—say six 18-horse power steam-engines—would come to £4800; making a total of £9400 to be laid out in establishing the service. The cost of maintenance, interest on capital, depreciation-fund, and incidental expenses, would amount to an additional £4000 per annum. This exceptionally brilliant illumination would be employed on the average for about three hours of the night tide, or, for the year, a total of 65,700 hours. The net cost per hour of each electric lamp would therefore be 1s. 2·6d. Taking gas as the illuminating agent, in order to obtain an equal amount of light to that afforded by the electric lamps, it would be necessary to employ 67 of the improved gas-burners. These burners consist of two concentric rings superposed, and pierced laterally with small holes, somewhat similar to those made in devices used for public illumination. They furnish the light of 190 candles with the consumption of from 56·5 to 60 cubic feet per hour. The annual consumption of gas would be about 4,145,000 cubic feet, which, at 4s. per 1000, would amount to £828 per annum, or 3d. per lamp per hour. It will thus be seen that the electric light would cost nearly five times as much as gas for an equivalent amount of illumination furnished.

SUCCESSFUL MANAGEMENT OF GAS-WORKS.

In a recent number of the *Journal für Gasbeleuchtung* was a communication from Mr. C. J. Hanssen, C.E., of Flensburg, on the gas supply of Nakskov. The author has since courteously furnished us with a translation of it. He said: How much the consumption of gas can be developed even in small towns (and, of course, still more in large towns) by treating the public in a fair and liberal manner may be seen from the working of the gas-works at Nakskov, a small seaport town on the Danish island Laaland, of which I, from official sources, send you the following data:—

The town of Nakskov has, within reach of the gas-mains, 3900 inhabitants (in 1876 there were about 3500) and about 500 houses, mostly one-storeyed, inhabited by one family. Nakskov is chiefly a commercial and shipping, not a manufacturing place, and it is by no means more than any other small town, enabled to develop a large consumption of gas, still the annual production is from 3200 to 3300 cubic feet per head of the population; and in spite of the very low prices charged for gas, the net income is upwards of 13 per cent. on the capital invested in the works.

The gas-works at Nakskov belong to the town. They were opened in 1862, and considerably extended in 1870. They contain at present 23 retorts (in five benches); two gasholders, together of 35,000 cubic feet capacity; the usual purifying and controlling apparatus; and 4900 yards of mains, from 6-inch down to 2-inch diameter. The mains are too small for the present consumption, and, consequently, the leakage is considerable. The coal used is Pelton and Pelaw Main, and in winter 5 per cent. of cannel coal is employed.

The administration of Nakskov Gas-Works has taken great pains to make the use of gas profitable and convenient to the public, and has particularly encouraged its use for cooking and other household operations, thus creating a demand during the daytime, and during the summer months. How excellent results have been obtained may be seen from the subjoined tables, which I have constructed and reduced to English standards from the kind communications of Mr. Thestrup, Chairman of the Gas Committee at Nakskov.

I.—*Increase of the Production of Gas at Nakskov in Successive Periods of Four Years.*

Year.	Production of Gas.	Cost Price of Coals per Ton.	Price of Gas per 1000 Cubic Feet. For Lighting.	Price of Gas per 1000 Cubic Feet. For Cooking.	Gas-Meters in Use.
	Cubic Feet.	s. d.	s. d.	s. d.	
1862 ..	3,340,000 ..	19 8 ..	7 8 ..	7 8 ..	193
1866 ..	3,784,000 ..	19 1 ..	5 10 ..	3 7 ..	361
1870 ..	6,435,000 ..	19 3 ..	4 6 ..	3 7 ..	400
1874 ..	9,177,000 ..	29 3 ..	4 10 ..	3 10 ..	458
1875 ..	— ..	— ..	4 5 ..	3 4 ..	—
1878 ..	12,727,000 ..	19 9 ..	4 5 ..	3 4 ..	571

The above prices are charged to all consumers, no discount is allowed.

II.—*Results of Working at the Nakskov Gas-Works.*

	1876.	1877.	1878.
Number of inhabitants within reach of the mains	3,500	3,700	3,900
Number of gas-meters for lighting gas	268	263	261
Number of gas-meters for cooking and heating gas	264	280	310
Total number of gas-meters	532	543	571
Total production of gas . . cubic feet	11,673,000	11,983,000	12,727,000
Greatest daily production of gas "	53,000	55,600	54,600
Least daily production of gas "	17,000	17,000	18,000
Production of gas per head, annual "	3,335	3,239	3,263
Production of gas per head, daily, maximum . . . . . cubic feet	18	15	14
Production of gas per head, daily, minimum . . . . . cubic feet	5	46	46
Total consumption of gas at the works . . . . . cubic feet	170,000	171,000	172,000
Total consumption of gas in the public lamps . . . . . cubic feet	525,000	824,000	824,000
Total consumption of gas by meter—lighting gas . . . . . cubic feet	5,048,000	4,983,000	5,097,000
Total consumption of gas by meter—cooking and heating gas . cubic feet	3,946,000	4,191,000	4,717,000
Total consumption of gas by leakage and condensation . . . . cubic feet	1,984,000	1,815,000	1,917,000
Consumption of lighting and cooking gas, in per cent. of the annual consumption—	L. C.	L. C.	L. C.
First quarter, from Jan. to March. .	17·8 9·9	17·2 10·9	16·1 11·1
Second quarter, from April to June .	7·3 11·0	6·8 10·7	6·4 11·6
Third quarter, from July to Sept. . .	8·5 10·9	7·8 10·9	7·8 11·7
Fourth quarter, from Oct. to Dec. .	22·4 12·2	22·6 13·1	21·7 13·6
Average of the year	56·0 44·0	54·4 45·6	52·0 48·0
Coals carbonized (New Pelton and cannel) . . . . . tons	1,190	1,203	1,185
Coke made (net produce) . . . bushels	33,800	34,800	34,200
Tar produced . . . . . gallons	11,800	10,000	11,700
Retorts in use (greatest number in December)	17 (4 ovens)	12 (2 ovens)	12 (2 ovens)
Cost price of coals . . . . . per ton	22s. 4d.	21s. 2d.	19s. 9d.
Selling price of coke . . . per bushel	6½d.	6d.	4½d.
Selling price of tar . . . . per gallon	1s. 0½d.	8d.	6d.
Selling price of gas for lighting . per 1000 cubic feet	4s. 5d.	4s. 5d.	4s. 5d.
Selling price of gas for cooking . per 1000 cubic feet	3s. 4d.	3s. 4d.	3s. 4d.
Cost price of gas sold by meter, exclusive of interest on capital . per 1000 cub. ft.	23·1d.	22d.	21d.
Six per cent. interest on capital . per 1000 cubic feet	10·1d.	10·2d.	9·6d.
Total cost price . per 1000 cubic feet	33·2d.	32·2d.	30·6d.
Capital invested in the works	£6830	£7220	£7220
Net profit in per cent. on capital invested	13·6	13·2	13·2

C. J. Hanssen, C.E.

Flensburg, June 10, 1879.

Sale of Gas Shares at Newmarket.—Last Thursday, 323 shares, all fully paid up, in the Victoria (Newmarket) Gaslight and Coke Company, Limited, were sold by auction in 24 lots. The first 8 lots of ten ordinary £5 shares sold for £78, £77, £80, £79, £80, £80, £80, and £81 respectively. Lot 9, fifteen similar shares, sold for £121. Lot 10, fifty £2 shares, bearing a guaranteed dividend of 6 per cent., sold for £119; and lot 11, fifty-two similar shares, for £116. Lots 12, 13, 14 were ten, ten, and eleven shares of £5 each, bearing a guaranteed dividend of 5 per cent., and sold for £55, £55, and £60 respectively. Lots 15 to 23 were each ten new shares of £5, and lot 24 five similar shares. These sold for £83, £80, £83, £83, £85, £85, £86, £86, £85, and £45. The purchaser of lot 15 was Mr. T. Wilkinson, the Manager of the Company.

TRADE NOTES FROM SCOTLAND.

(FROM OUR OWN CORRESPONDENT.)

I shall not ask to follow Mr. Miller in your ordinary "Correspondence" columns on the question of the "Cheapest Gas in Scotland," as discussed in his letter in last week's JOURNAL; and even in the place usually set apart for my "Notes" I do not wish to say much on the subject referred to. As your regular correspondent, I must admit that there is some degree of satisfaction in having my statements called in question, for that very fact alone shows that there are some persons who take a certain amount of interest in the news-notes which it is my business to provide for the readers of the JOURNAL. If I have claimed for Dundee gas more than what it is really entitled to, I must confess that it was the price pure and simple that weighed with me—the price at the time at which I wrote, and not after the lapse of two or three weeks or any other period of time. Without deeming it necessary to refer to the slight difference in illuminating power in Dundee and Galashiels gas, I thought it proper to draw special attention to the fact that Dundee was now getting the *lowest-priced* gas in Scotland, in the same way as I did on previous occasions when speaking of the price of gas in Galashiels, Coatbridge, and possibly one or two other Scotch towns. I like to assist in stimulating a little friendly rivalry, and I am pleased to know that Galashiels, a comparatively small town, can set such a good example, as is claimed for it by our friend Mr. Miller, to very much larger towns, such as are much nearer to the fields of gas coal. Please mark that I am not admitting the incorrectness of my statement as to the cheapness of gas in Dundee, and on that point I shall leave Mr. Miller in the hands of the Editor of the *Dundee Advertiser*, who has done him the honour to refer, in the leading columns of that paper, to his letter in last week's JOURNAL. I hope that the question which I have been the innocent cause of raising will be well discussed before it is set at rest, and in conclusion I must express a little wicked delight in knowing that the question is now no longer one of Galashiels *v.* Hawick, the capital of tweeds against the head-quarters of hosiery, but rather the capital of tweeds against the juteopolis on the banks of the Tay.

We shall now have some of the actual facts in reference to the Dundee gas-supply undertaking, as stated at the annual meeting of Gas Commissioners, held last Wednesday, when the accounts for the past year and the estimates for the present year were submitted. Mr. Mitchell, the Convener of Finance, stated that the revenue for the year had been £61,117 5s. 10d., and the expenditure £58,282 7s. 6d., leaving a surplus of £2834 18s. 4d. The amount of gas manufactured had been 322,807,700 cubic feet, being an increased of 5½ millions over that of the previous year. The estimated expenditure for this year was £57,289, and it was proposed that the price of gas should be reduced from 3s. 11d. to 3s. 8d. per 1000 feet, with discount of 5 per cent. on all accounts paid within 28 days. The discount system had worked most satisfactorily. The bad debts only amounted to £176, or about 6s. per cent., while in 1870-71, when about half the present quantity of gas was sold, the bad debts amounted to £668, or about 17s. per cent. The meeting considered that the accounts and prospects of the Commission were very satisfactory, and approved of the accounts and estimates, and fixed the assessment at the rate mentioned. For the benefit of gas managers and other persons interested in gas affairs elsewhere, I may mention a few additional facts. The actual quantity of gas sold last year was 271,205,400 cubic feet, and about 2½ million cubic feet were consumed at the works, so that the quantity unaccounted for by leakage, &c., was rather over 49 million cubic feet. The quantity of gas under the head "unaccounted for" is gradually diminishing. It was estimated a year ago that the amount of coals required would be £29,091 tons, costing £32,000; but the fact is that only 28,329 tons were carbonized during the year, the cost of which, together with the firemen's wages, and charges for breaking coals, haulage, and waggons, was £31,172 14s. 6d., or 22s. per ton. The produce of gas per ton of coals was actually 11,394 cubic feet, or 394 feet in excess of the estimated produce. For the present year's supply of gas, estimated at 325,000,000 cubic feet, 29,545 tons of coal will be required, the contracts for which have been made at an average price of 17s. per ton, delivered at the works.

The annual meeting of the Dunoon Gaslight Company was held on Saturday, the 14th inst., Provost Oswald, Chairman of the Company, presiding. On the recommendation of the Directors, a dividend of 10 per cent. was declared on the past year's transactions.

At a meeting of the Forfar Gas Commissioners, held on Monday night last week, Bailie Laird remarked that from the adoption of certain remedial measures, the leakage in the town, which had been, he believed, the greatest in Scotland, would henceforth be reduced to 8 per cent.

A reduction in the price of gas from 4s. 2d. to 3s. 9d. per 1000 cubic feet has been recommended by the Directors of the Hawick Gaslight Company.

The annual general meeting of the Muirkirk Gaslight Company was held on Monday, the 16th inst.—Mr. Andrew Howatson, of Darnel, Chairman of the Company, presiding. The usual dividend of 10 per cent. was ordered to be paid to the Shareholders for the year ending on the 31st ult., and the price of gas was continued at 5s. per 1000 cubic feet.

Since the statement was made regarding the expected reduction in the price of gas at Arbroath, a general impression has prevailed in the town that the price of gas was never so low as it is at present. But that is not correct, for in the years 1862-63 and 1863-64, before the gas-works passed into the hands of the Town Council, the same price was charged.

The annual meeting of the Shareholders of the Coatbridge Gas Company was held last Wednesday—Mr. John Alexander, Gartsherrie Iron-Works, Chairman of the Company, presiding. In accordance with a recommendation in the report submitted by the Directors, the maximum dividends of 10 and 7 per cent. respectively on the old and new shares were declared, leaving a balance to be carried forward. It was unanimously resolved for the future to declare a dividend half yearly, in June and December.

On the evening of Monday, the 16th inst., a gas-lamp of an improved description, and of great illuminating power, was displayed opposite the Queen's Statue at the corner of St. Nicholas Street, Aberdeen, and attracted considerable attention. The lantern, which is about 6 feet in height, is lighted by Wigham's patent gas-burners, which are exactly similar to those used in lighthouses. The illuminating apparatus consists of a combination of 28 fishtail jets, placed so that the upper portions of the different flames unite, producing a powerful and brilliant light. To obviate the smoke caused by so many jets, a very ingenious oxidizer of talc is placed over the flame, not only preventing smoke, but rendering the light exceedingly white, and provision is also made for equalizing the current of air to the flame and carrying off the foul air. The illuminating power of the lamp, which is among the smallest sizes manufactured, is stated to be 429·6 sperm candles, with a consumption per hour of about 35 feet of gas. It is stated that two other patent lamps have been ordered, and will probably be placed in the vicinity of Union Bridge. During Monday night the light increased in brilliancy and power, and lighted up remarkably well a large area around. The handsome appearance of the lantern is also in its favour. It is believed that twelve of the ordinary lamps in the vicinity can be dispensed with in consequence of the erection of the new lamp.

Glasgow Corporation 6¾ per cent. Gas Annuities advanced in price from £154 12s. 6d. to £157 10s. on Monday last; the 9 per cent. rose to £212 5s. on Thursday; and there was a further advance of 5s. on the following day. On that day also the Glasgow Corporation 4 per cent. Water Annuities advanced in price on the Edinburgh Stock Exchange from £102 15s. to £103 5s.

Last week's Glasgow pig iron warrant market was dull, and prices again receded. The range was 41s. 7d. cash on Monday to 41s. 1½d. on Tuesday; 41s. 1d. on Wednesday, and 41s. 2d. on Thursday; and on Friday there was a slight improvement. The market continues lifeless.

Nothing new falls to be reported in regard to the coal market.

GAS FROM MINERAL OIL.—Government House, Simla, has, says the *Times of India*, been lighted with gas made from mineral oil. The system has also been tried, with every success, at the Lahore railway station.

PROPOSED PURCHASE OF THE HINCKLEY GAS-WORKS BY THE LOCAL BOARD.—An extraordinary meeting of the Hinckley Local Board was held on Tuesday, the 10th inst., when it was reported that the Gas-Works Committee appointed had met the Directors of the Gas Company, and they were quite willing to sell the works for £30,000, with an additional amount for improvements, coal, &c. A motion that the Board should purchase the works at that amount was unanimously agreed to; and the matter now rests with the Shareholders of the Company.

PRESENTATION TO MR. J. ALLINGHAM.—Mr. James Allingham, Chief Inspector of the Phœnix Gaslight and Coke Company, has retired with a pension, after a service with the Company of nearly fifty years. His fellow-officers and about 120 of the workmen have demonstrated his popularity and their warm appreciation of his kindly and sterling character by presenting him with a handsome tea service in silver. At the presentation, on Wednesday last, Mr. Allingham was received with much cheering, and acknowledged in a few well-chosen words the sympathetic sentiments expressed towards him.

THE RECENT VISIT OF THE BRITISH ASSOCIATION OF GAS MANAGERS TO NEWCASTLE.—The *Shields Daily News* of the 16th inst. says: "The British Association of Gas Managers meeting in the Lecture Hall of the Literary and Philosophical Society, Newcastle, is a circumstance that has awakened the most lively interest in our northern communities, bringing, as it does, clearly before the public the great scientific advance made by this branch of industry. Gas-works have long been thought of as a tolerated nuisance, ranking along with shambles and knackers yards as necessary evils; but we are beginning to perceive what variety of good is brought out of the seeming evil. The genius of the lamp has been discovered in the neighbourhood of the unsightly gasholder, and has given us beauty for ashes in many a useful product, while the recent electric disturbance has put the gas authorities into great activity, and enabled the public to comprehend the real progress made in gas lighting. It has served to convince all unprejudiced observers that the beneficent application of gas is merely in its infancy, and that whatever may be the progress of electric discovery and application, a noble and independent service will always be maintained by the gas companies. It is needless to say that South Shields has been largely interested in the gathering. The presence of Mr. Warner as President was enough to elicit our warmest regard. Much in the proceedings that has surprised the general public was familiar to us, through our intercourse and daily observation of one of the most scientific and spirited of gas managers. The perseverance and success with which Mr. Warner has striven to increase the useful applications of gas has added greatly to the domestic comfort and economy of the borough; and, knowing how far he is in advance of the ordinary manager, it is a pleasure to his neighbours to see his acquirements and capacity most widely recognized and honoured. Long before the electric thrill provoked the increased action of the retorts, we had been made familiar with the advanced applications of gas, and owed to him entirely the success of our pleasant exhibition of gas apparatus."

Register of New Patents.

4420.—KROMSCHRÖDER, J. F. G., Walthamstow, Essex, for "*Improvements in means or apparatus for carburetting and purifying coal gas.*" Patent dated Nov. 23, 1877.

This invention has for its object improvements in means or apparatus for carburetting and purifying gas coal. For this purpose the gas is led into a chamber provided with a circuitous passage filled with horsehair or other absorbent material, and supplied with a carburetting fluid from a reservoir situated above such carburetting chamber, by means of a bird-fountain arrangement, so as to maintain the liquid in such chamber at a given level. The gas, after traversing through the circuitous channel of the carburetting chamber, is led into a flexible storing chamber, the cover of which is weighted with capability of regulation to suit the pressure required to cause the gas and the carburetting vapour to become intimately combined. After being carburetted and purified, the gas is led from this flexible chamber to the burners by a pipe opening into the lower part of the chamber in which such flexible chamber works.

4423.—GORDON, J., Glasgow, "*Improvements in apparatus for controlling and regulating the supply of water and preventing waste.*" Patent dated Nov. 24, 1877.

This invention relates to improved apparatus for controlling and regulating the supply of water and preventing waste, and is advantageously applicable in connection with water-closets, urinals, lavatories, &c.

The improvements are to be applied in connection with a float-valve or ball-cock of any suitable kind, which may be fitted to a service-pipe proceeding directly from the main or from an overhead cistern.

4434.—CLARK, W., Chancery Lane, "*Improvements in apparatus for condensing liquefiable gases and condensable vapours, and for cooling liquids.*" A communication. Provisional protection only obtained. Dated Nov. 24, 1877.

This invention relates to improved apparatus for condensing liquefiable gases and condensable vapours, and is applicable for refrigerating liquids generally.

The principle of the apparatus is based on the complete subdivision of the gaseous or liquid matters (which are very poor conductors of heat) into a number of streams of infinitesimal size, whereby they are brought to the best possible condition for being cooled, and consequently liquefied or condensed, by direct contact with metallic surfaces.

In the apparatus employed, the condensable vapours and liquefiable gases are caused to traverse the meshes of a series of excessively fine wire gauze diaphragms, arranged at intervals within a tube. The vapours and gases are thus subdivided into an infinity of small streams, the diameter of which may be even less than a fourth of a millimètre; and as the result of this subdivision is to bring these minute streams into immediate contact with metallic surfaces, which are excellent conductors of heat, it will be readily seen how rapidly the heat of the vapours and gases will be transmitted from the centre of the streams to the refrigerating surfaces.

4435.—VARLEY, S. A., Hatfield, "*Improvements in electrical apparatus for lighting and other purposes.*" Patent dated Nov. 24, 1877.

In the specification of a former patent, granted to the present patentee on

the 19th of December, 1876 (No. 4905), are described certain improvements in dynamo-electric machines for producing the electric light, and for other purposes where electricity in large quantities is required. The improvements so described refer to machines of a class previously described in a provisional specification of 1866, in the names of Cornelius Varley and Samuel Alfred Varley (No. 3394), and in the specification of a patent granted to them in 1867 (No. 1755). The principle consists in causing electricity and magnetism developed by the expenditure of mechanical force to act and re-act on one another in the machine itself in such a way as to develop a greatly increased amount of both these forces.

In machines as described in the specification of the patent of Dec. 19, 1876, a number of soft iron cores, or bobbins, are wrapped with insulated wire, and mounted on an axle, by means of which they are revolved, and there are commutators for sending the currents in the required directions. These bobbins revolve between opposite poles of soft iron magnets, which are also wrapped with insulated wire.

The soft iron magnets are so arranged that they present north and south poles alternately, and opposite to one another, and the bobbins, when revolved, are magnetized first in one direction and then in the other, positive and negative electric currents being developed in the insulated wires of the bobbins alternately at each reversal of the magnetic polarity. The commutator closes the electrical circuit through the insulated wire of the bobbins, and the soft iron magnets, the electricity passing round the magnets in the direction to increase their magnetic polarity, which increased polarity re-acts upon the bobbins, developing an increased amount of electricity.

The development of the electrical and magnetic forces is to a considerable extent separated, to obtain increased magnetic potential in the bobbins, which at a later stage becomes converted into electricity of a correspondingly high potential. To effect this, the bobbins are divided into groups, the alternations of north and south poles, between which the bobbins revolve, corresponding to the number of groups.

The number of bobbins in each group may be two, three, four, or more; the number of commutators employed may correspond to the number of bobbins forming a group; or they may be increased in number, and when electricity of a very high potential is desired, the commutators may be increased to the same number as the bobbins.

The present invention has reference chiefly to machines of this class, and has for its object the more complete conversion of the mechanical force consumed into electric currents, especially for producing the electric light and the distributing of the currents, so as to divide the light produced, in order that the illumination may be more uniform. This is effected chiefly by improved construction of the various parts of the apparatus above referred to.

4449.—Harrison, H., Huddersfield, York, "*Improvements in water-taps or cocks.*" Provisional protection only obtained. Dated Nov. 26, 1877.

In the construction of taps for domestic purposes, a leather washer is employed for forming the valve, but this soon wears away by usage.

This invention consists in dispensing with such leather washer, and in lieu thereof a loose ball, made of india-rubber, wood, or other material, is used. For taps working at high pressure the patentee prefers to place this ball under the valve-seating, so that the pressure of water forces the ball up to the seating, and entirely closes the passage.

The ordinary screw of the tap is slightly enlarged, or "cupped," at its bottom end, and rests upon the said ball, so that when the tap is required to be opened, the screw is turned in the usual manner, and pushes the ball from the seating, thereby allowing water to escape, and immediately the screw is turned in the opposite direction, the pressure of the water forces the ball back to its seat, and closes the tap.

For taps working at low pressure or used for hot water it is preferred to place the ball on the top of the seating, with the enlarged or "cupped" end of the screw resting upon it, as in the previous case.

4452.—Wise, W. L., Adelphi, London, "*Improvements in lighting apparatus.*" A communication. Patent dated Nov. 26, 1877.

The improved appliance the subject of this invention, and to which is given the special names of "pyrophore," or "perpetual lamp match," is based upon the well-known property possessed by what is called spongy platinum, of storing up hydrogen gas combined with oxygen, with the result that the spongy platinum is brought to a red heat, a slight detonation is produced, the jet of hydrogen ignites, and is capable of at the same time lighting a small lamp arranged for that purpose.

[The invention is not described apart from the drawings.]

4463.—Cullen, P., and M'Kellar, P., Glasgow, "*Improvements in service and stop cocks, cranes, or valves.*" Provisional protection only obtained. Dated Nov. 27, 1877.

This invention has reference to improvements in the construction of the shutting and opening parts of service stop-valves, taps, cocks, or cranes, for water and other liquids, which are more simple, efficient, and liquid-tight than hitherto, so as to save the present great waste of water when they are applied for domestic and public service purposes.

The novelty of the invention, when applied to an ordinary swan-neck cock or tap valve for household service purposes, consists in forming the opening and closing part of the valve with a parallel or cylindrical stem, with a bevel or conical end working on a corresponding hollow conical seat below, between the inlet and outlet channels or branches of the valve chest, the valve and its stem being inserted and guided in a stuffing-box or screw-closing cover chamber formed above the seating, with a single or double cup leather inserted round it at the bottom of the recess, and which might be fixed by the bottom edge of the cover screwed into the seat metallic-surface tight, preferably secured with a side pinching screw to prevent it from turning, this cover being made hollow, and screwed on the inside above the liquid-tight cap, into which a major screw on the valve-spindle works or screws up, and by a handle outside above the stuffing-box cover, so as to open and close the valve from its seat, and so admit or shut off the water through the tap or valve as usual, the cup leather preventing all escape through the screws of the cover and valve spindle without other stuffing or packing.

A further improvement refers to the cock or chamber part of the swan-neck tap or key, which is retained in its chamber by the usual friction washer and tightening nut at the smaller end, and consists in forming a small annular recess round the chamber of the key opposite the inlet branch, with a small hole bored through and leading into the interior of the hollow key, all so that in whatever position the key and its swan-neck may be turned or placed, the water will flow and be delivered through these when the valve is lifted, and *vice versâ*, only shut when the valve is shut, so that the flow of the water is not controlled in any way by the swan-neck cock, which so frequently gets out of order and wastes water by the inattention of the user, who frequently leaves the valve open, and controls the flow by the swan-neck key, but who, not being able to do this by the improved tap, is obliged to screw down the valve to save the annoyance of the full flow of the water.

4479.—Aube, P., Toulon, France, "*Improvements in the manufacture of gas, and in apparatus used in its production.*" Patent dated Nov. 28, 1877.

[The apparatus is not described apart from the drawings.]

APPLICATIONS FOR LETTERS PATENT.

2345.—Turner, J., Walworth, London, "A 'gas consumers' meter recorder." June 13, 1879.

2366.—Bradshaw, J., Haworth, J., and Parkinson, R., Blackburn, Lancs, "Improvements in gas lighting apparatus." June 14, 1879.

2381.—Downing, W., Smith, G. J., and Romans, W., Sheffield, Yorks, "Improvements in retort-lid fastenings." June 16, 1879.

2386.—Hartmann, W. E. A., Swansea, Glamorgan, "Improvements in the manufacture or production of sulphuretted hydrogen gas." June 16, 1879.

2391.—Gould, R. H., Battersea Park Road, London, "Improvements in fluid-meters, parts of which improvements are also applicable to other similar purposes." June 17, 1879.

2402.—Edison, T. A., Menlo Park, U.S.A., "Improvements in electric lights, and in apparatus for developing electric currents and regulating the action of the same." June 17, 1879.

2422.—Horsley, C., Highbury New Park, London, "Improvements in apparatus used in the distribution of gas." June 18, 1879.

2424.—Clerk, D., Glasgow, "Improvements in gas motor engines." June 18, 1879.

PATENTS WHICH HAVE PASSED THE GREAT SEAL.

783.—Harding, G. P., Paris, "Improvements in apparatus or appliances for obtaining electric light." Feb. 26, 1879.

1410.—Haddan, H. J., Westminster, "Improvements in purifying and increasing the illuminating power of gas." A communication. April 9, 1879.

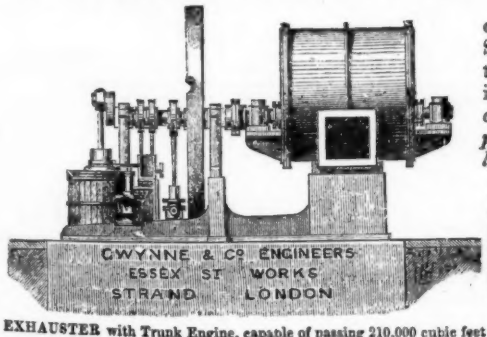
PATENT WHICH HAS BECOME VOID

BY REASON OF THE NON-PAYMENT OF THE ADDITIONAL STAMP DUTY OF £50 BEFORE THE EXPIRATION OF THE THIRD YEAR.

2409.—Fison, F. W., "Improved means or apparatus for exhausting gas retorts." June 10, 1876.

The GRAND MEDAL of MERIT at the VIENNA EXHIBITION, TWO MEDALS at the PHILADELPHIA EXHIBITION and TWO MEDALS at the PARIS EXHIBITION, have been AWARDED to GWYNNE & CO. for GAS-EXHAUSTERS, ENGINES, and PUMPS; Also 27 OTHER MEDALS AWARDED at all the GREAT INTERNATIONAL EXHIBITIONS.

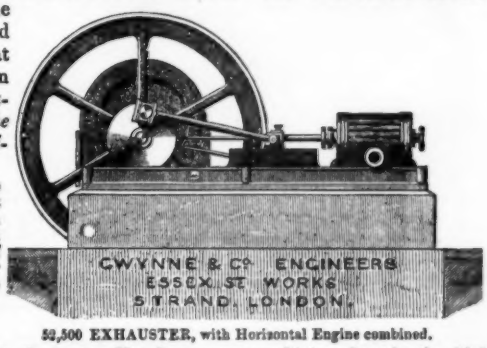
GWYNNE & BEALE'S PATENT GAS-EXHAUSTERS & ENGINES.



EXHAUSTER with Trunk Engine, capable of passing 210,000 cubic feet per hour.

The Judges report on the combined Exhauster and Steam-Engine exhibited at the Philadelphia Exhibition is—"*Reliable compact Machine, well adapted for the purpose intended, of excellent workmanship.*"

GWYNNE & CO. have made the largest and most perfect Gas-Exhausting Machinery in the world, and have completed Exhausters to the extent of 8,000,000 cubic feet passed per hour, of all sizes from 2000 to 210,000 cubic feet per hour.



52,500 EXHAUSTER, with Horizontal Engine combined.

GWYNNE & CO. do not pretend to enter into a struggle with other makers in respect to cheapness. They have never sought to make price the chief consideration, *but to produce machinery of the very highest quality, and most approved design and workmanship.* The result is that in every instance their work is giving the fullest satisfaction. Numerous testimonials and references can be given to Companies using their Machinery for years past.

Exhausters, with or without Engines combined, can be made to pass the gas WITHOUT OSCILLATION OR VARIATION IN PRESSURE Regulators, Bye-Passes, Stop-Valves, Gas-Valves, Station Governors, and Gas Machinery of all Sizes.

PLEASE ADDRESS IN FULL, GWYNNE & CO., Hydraulic and Gas Engineers, ESSEX STREET WORKS, VICTORIA EMBANKMENT, LONDON, W.C., ENGLAND.

Gwynne & Co.'s New Catalogue on Gas-Exhausting and other Machinery may be obtained on application at the above Address.

WANTED, Readers of the NEW Edition, 1879, "Cooking & Heating by Gas;" on Burners, &c. Copies, by post, Threepence, direct from the Author, MAGNUS OHREN, A.I.C.E., Gas-Works, SYDENHAM, S.E.

WANTED, Masonic Votes on behalf of a Child of the late Bro. John Johnson, who was a Subscribing Member of the "Evening Star Lodge," No. 1719, and a Member of the British Association of Gas Managers.

Votes received by Bro. MAGNUS OHREN, Lower Sydenham, KENT, Secretary of the Lodge.

WET AND DRY GAS-METER AGENCY.

WANTED, a Gentleman who has a Connection with Gas Engineers, to Represent a good firm in London and district.

Address Box 9, Post Office, Oldham.

WANTED, an engagement as Assistant GAS-ENGINEER, by one who has received a Gas Engineer's education, and has worked before in the same position. First-class references.

Address No. 552, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, a man competent to under- take the Management of the Works of the Tewkesbury Gas Company, Limited. He must have a thorough Practical Knowledge of the Manufacture of Gas and of the Working Machinery connected therewith, and he must also be a good Fitter. Age about 30. A house, together with gas and coal, provided.

Apply, with references, to the SECRETARY, at the Gas-Works, TEWKESBURY, stating wages required.

TO GAS-WORKS MANAGERS.

WANTED, in a fortnight, a Manager for a small Gas-Works in Devonshire, who will be required to perform the whole of the duties connected therewith; but help will be provided in winter time.

The wages will be the year through 24s. per week, with house, coal, and light free.

Applicants must state age, family, and experience in management.

Address No. 553, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

TO GAS-WORKS MANAGERS.

WANTED, a thoroughly steady and reliable Single Man to proceed to Rawul Pindee—a healthy military station in India—to take charge of Oil Gas Works, and the Gas-Fittings connected therewith.

The salary fixed by the Government of India is 2600 rupees per year, and quarters. The engagement to be for five years. Free second-class passage out and home, and other advantages, particulars of which may be obtained on application as under.

References as to character and ability, with copies only of testimonials, to be sent to

GEO. BOWER.

St. Neots, Hunts.

TO GAS METER, CHANDELIER, AND GAS-STOVE MANUFACTURERS.

THE Advertiser, who has a large con- nection amongst Gas Companies, and now disengaged, is desirous of Representing a good Firm in any of the above businesses. Well known. Good reference, and security if required.

Address No. 551, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

MESSRS. CUTLER, Gas Engineers and Contractors, Millwall, have a Vacancy in their Drawing Office for a PUPIL; also an Improver.

Apply by letter, endorsed "D. O."

TO Gas Purifier Manufacturers, &c. A London firm, having travellers waiting upon Gas Companies in home and neighbouring counties, is desirous of representing a good house.

Address E732, Address and Inquiry Office, *Times* Office.

AN experienced Wood-Sieve Maker is open to a RE-ENGAGEMENT. In a Gas-Works preferred.

Address W. K., 12, Brill Terrace, Pancras Road, LONDON.

THE Manager and Secretary of a Gas- Works, making nearly 20 million cubic feet of gas per annum, wants a better situation, in a similar or any other capacity. The advertiser is not leaving his present situation. He is a young married man, and has filled his present appointment many years. Security, testimonials, and references.

This advertisement will not appear again.

Please address replies to No. 554, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

TO TAR DISTILLERS AND GAS COMPANIES.

AN energetic Young Man, of several years experience in Tar Distillation, is open to an engagement as MANAGER or SUB-MANAGER. Understands the Erection of Plant, Treatment of Benzole, Anthracine, Naphthaline, &c., &c.; also Sulphate of Ammonia Making. Testimonials.

To Gas Companies desirous of distilling their own tar this would be a good opportunity. Advertiser has no objection to go abroad.

Address No. 555, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

FOR SALE.

A Combined Purifier and Condenser, with Centre Change-Valve, suitable for 300 Lights.

Apply to the BRYMBO COMPANY, WREXHAM.

THREE Purifiers for Sale Cheap, size 8 ft. by 6 ft. by 4 ft.; lids equal to new. Also Dry Centre-Valve and Connections for same, 6-inch.

Apply to J. S. CRANMER, Gas-Works, STRATFORD-UPON-AVON.

GASHOLDER-TANK FOR SALE.

THE Dartford Gas Company have for SALE a Cast-Iron GASHOLDER-TANK, 35 ft. 6 in. in diameter, and 18 ft. deep, together with Columns, Inlet and Outlet Pipes, &c.

Further information may be obtained on application to W. P. MILLS, Manager to the Company, Dartford, KENT.

GOVERNOR FOR SALE.

THE Shanklin Gas Company, Limited, have FOR DISPOSAL a nearly new 8-in. Air Vessel Concentric GOVERNOR, with six Ornamental Pillars, 8-in. Four-way Bye-pass Cock with Connections. Makers, Messrs. W. and B. Cowan. To be moved to make room for extensions.

Can be seen and particulars obtained on application to W. SUTHERLAND, Secretary.

BUENOS AYRES GAS COMPANY, LIMITED, SIX PER CENT. DEBENTURES.

NOTICE is hereby given to the DEBENTURE-HOLDERS of the Buenos Ayres Gas Company, Limited, that the Half-Yearly COUPONS at the rate of 6 per cent. per annum, due on the 1st of July next, will be paid on and after that date at the Company's Bankers, Messrs. Prescott and Co., Threadneedle Street, London. Coupons must be left at the Bank three clear days for examination.

By order,

E. W. LAYTON, Secretary.

1, East India Avenue, Leadenhall Street.

FOR SALE, Two Purifiers, 8 ft. by 4 ft. by 4 ft. deep; very strong Covers, in good condition; Valves to work either one or both at once; Connections, &c., with Lifting Screw for Covers.

For particulars, apply and send offer to MANAGER, Lanark Gas Consumers Company, Limited.

PURIFIERS FOR SALE.

FOR SALE, price £60.—The Plates forming a Set of Two Purifiers, 12 ft. by 4 ft. 6 in. by 4 ft. deep, together with wrought-iron Covers, Lifting Tackle, Wood Sieves, Hydraulic Valve, and Connections. The above are all equal to new, and very handy, requiring little floor space.

Apply to the MANAGER, Gas-Works, STONEHAVEN, N.B.

EXHAUSTER FOR SALE.

FOR SALE, an Engine and Exhauster combined, to pass 7000 feet per hour, together with Boiler, 12 ft. by 4 ft., Boiler Fittings, Connections, Regulator, and Stone Bed.

For particulars, apply to W. T. TREW, Gas-Works, WARWICK.

TO BE SOLD, Cheap, Three Telescopic GASHOLDERS, two 60 ft. diameter and 20 ft. deep each lift, and one 70 ft. in diameter and 20 ft. deep. Only been in use eight years. May now be seen at work at the Effingham Street Gas-Works, Sheffield.

For price, apply to THOMAS PIGGOTT AND CO., Spring Hill, BIRMINGHAM.

THE Sunbury-on-Thames Gas Company have FOR SALE the following PLANT in good condition, thrown out to give place to larger:—

Two Purifiers, 6 ft. by 3 ft. by 3 ft. 6 in. deep.
Two do., 5 ft. by 3 ft. by 3 ft. deep.
6-in. Connections, with two Lifting Screws and Travellers complete.
Six 6-in. Cathels's Patent Four-way Valves.
Station-Meter to pass 1500 ft. per hour, 4-in. Connections.
4-in. Governor.
3-in. Pipe Condenser.
Six 6-in. Donkin's Valves.

For further particulars apply to Mr. JOHN SMITH, Manager, Gas-Works, Sunbury-on-Thames, MIDDLESEX.

TO SULPHATE OF AMMONIA MAKERS.

PLANT Erected or Plans and Specifica- tions of Apparatus Supplied for an Improved Method of Efficient and Economical Systems for Making Sulphate of Ammonia; described in No. 839 of this JOURNAL.

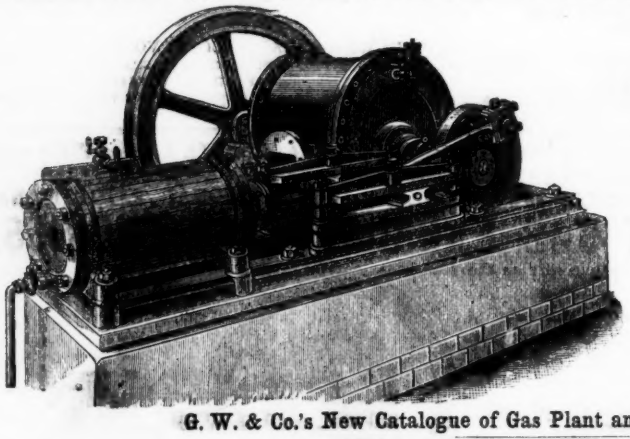
For terms, address JOHN G. HARVEY, 31, Old George Street, CORK.

BEALE'S IMPROVED PATENT GAS EXHAUSTERS,

WITH

Wrought-Iron Spindles and

ENGINES COMBINED.



SOLE MAKERS,

GEORGE WALLER & CO.

**MAKERS OF ENGINES, EXHAUSTERS,
INDEX AND DISC GAS-VALVES,
HYDRAULIC MAIN VALVES,
BYE-PASS VALVES,
TAR, LIQUOR, AND OTHER PUMPS,
SCRUBBERS AND PURIFIERS,
CONDENSERS, BOILERS, &c.**

G. W. & Co.'s New Catalogue of Gas Plant and Machinery can be had on application.

Phœnix Engineering Works:

HOLLAND STREET, SOUTHWARK, S.E.

TO GAS ENGINEERS.

D. BRUCE PEEBLES & CO.

Beg to call the attention of Gas Engineers to the fact that the novel and original feature in connection with PEEBLES' SYSTEM OF CONTROLLING THE ACTION OF GAS GOVERNORS is the loading or acting on the Bell by Pneumatic Pressure instead of Weights.

TAY WORKS, BONNINGTON, EDINBURGH.

CHEPSTOW GAS EXTENSIONS.

THE Directors of the Chepstow Gas Company are desirous of receiving TENDERS for the Supply and Erection of a Foul Main Pipe, a Steam Boiler, an Engine and Exhauster, and a Livesey's Washer.

For further information, address, WILLIAM DONÉ, CHEPSTOW.

THE Directors of the Cirencester Gas Company, Limited, are prepared to receive TENDERS for the Supply of 600 Tons of Real Old Silkstone GAS COAL; 600 Tons of best Forest of Dean GAS COAL, and 500 Tons of through Penygraig Welsh COAL, to be delivered at Cirencester Station during the next Twelve months, in such quantities and at such times as the Gas Company's Manager may direct.

Also for the purchase of the Company's COKE, to be removed from the works by the Contractor as required by the Manager.

Tenders to be sent to J. BERCHAM, Secretary to the Gas Company, on or before the 1st of July next.

TO MANUFACTURERS OF GAS-ENGINES, GAS COOKING STOVES, LAMPS, AND BURNERS.

THE Gas Committee for the Corporation of East Retford beg to inform the above that they will Supply GAS free of charge to EXHIBITORS at the Nottingham and Nottinghamshire Agricultural Show, to be held at Retford, July 22nd and 23rd.

A gas-main will be laid ready for all to attach service. Schedules of prizes are now ready, and may be had, post free, on application to John Barrow, Hon. Sec., 16, Market Street, Nottingham.

Any further particulars will be given by applying to F. BAILEY, Manager.

Price 28s., handsomely bound in Morocco, cloth sides, gilt edged and lettered.

THE FIRST VOLUME OF

KING'S TREATISE

On the Science and Practice of the Manufacture and Distribution of

COAL GAS.

Edited by THOS. NEWBIGGING, C.E., M.Inst.C.E., and W. T. FEWTRELL, F.C.S.

Orders received by

WALTER KING, 11, Bolt Court, Fleet Street, London, E.C.

CITY OF CARLISLE.

TENDERS FOR COAL AND CANNEL.

THE Carlisle Gas Committee are prepared to receive TENDERS for the Supply of about 10,000 Tons of Screened or Unscreened GAS COAL, and about 2000 Tons of CANNEL, to be delivered in Carlisle in such quantities as may be directed from July, 1879, to June, 1880.

Tenders, specifying the description of the Coal or Cannel, the pits at which they are raised, and the terms for net monthly payment, are to be sent to me, on or before July 3, 1879, endorsed "Tender for Coal."

J. HEPWORTH, Engineer and Manager.

Gas-Works, Carlisle, June 19, 1879.

THE Directors of the Glossop Gas Company are prepared to receive TENDERS for the supply of COAL and CANNEL for a period of One, Two, or Three years, to be delivered at Glossop Station in such quantities as required, commencing September next. Probable quantities per annum:—

1000 Tons of best screened Cannel,
3000 Tons of best screened Gas Coal,
200 Tons of best screened Gas Nuts

Tenders, specifying the description of Coal and Cannel, the pits at which they are raised, price per ton of 20 cwt., to be sent in not later than the 28th inst.

The Directors do not bind themselves to accept the lowest or any tender.

By order of the Board,
JAMES DALGLIESH, Manager, &c.

Gas-Works, Glossop, June 10, 1879.

Prices, half bound, cloth sides, 2 quires, 30s.; 3 quires, 36s.; other sizes and bindings to order.

THE

GAS COMPANIES EXPENDITURE JOURNAL,

Being a Ruled Account-Book with Printed Headings, and Analyzing Guide for Keeping, upon the easiest and most correct method, the Expenditure of a Gas Company, in accordance with the provisions of the Gas-Works Clauses Act of 1871, and suitable for all Companies.

Specimen, with illustration and full particulars; 2s. 6d. returned on the purchase of a "Journal."

Published by SANDELL AND SON, Accountants, 2, Great George Street, WESTMINSTER, and W. KING, Office of the JOURNAL OF GAS LIGHTING, 11, Bolt Court, FLEET STREET, E.C.

THE Gloucester Gas Company, ceasing to manufacture gas at their old works, will have the undermentioned APPARATUS for Sale about the beginning of August, viz.:—

110 Mouthpieces, D-shape, 13 in. by 22 in., with Wrought-Iron Lids, Cross-Bars, Stand, Bridge, and Dip Pipes. Also about 150 feet of D-shape Wrought-Iron Hydraulic Main, size 19 in. by 19 in. 28 Mouthpieces, D-shape, 16 in. by 20 in., with Wrought-Iron Lids, Cross-Bars, Stand, Bridge, and Dip Pipes. Also about 38 ft. of D-shaped Wrought-Iron Hydraulic Main, size 20 in. by 20 in. Annular Condenser, consisting of six Vertical Pipes, 24 in. diameter, 19 ft. high, with three 12 in. Slide-Valves and 12 in. Connections.

Scrubber (round), 5 ft. by 20 ft., with three 12-in. Slide-Valves, and 12 in. Connections.

Exhauster (Jones) to pass about 15,000 feet per hour.

Exhauster (Beales) to pass about 25,000 feet per hour.

Two Vertical Steam-Engines, each about 6-horse power, with Pulleys, and Shafting used for driving the above.]

Boiler 14 ft. 6 in. by 3 ft. 6 in., with Centre Tube, and four Galloway Patent Tubes.

4-horse power Horizontal Steam-Engine.

Three 4-in. Pumps, with cranked Shafting and a pair Mitre Wheels.

Set of four Purifiers, 12 ft. by 12 ft. by 4 ft., with 12-in. Centre-Valve (Cockeys), and Connections and Lift complete.

Station-Meter by A. Wright and Co., London, with three 12-in. Slide-Valves, and 12-in. Bye-Pass and Connections, to pass about 25,000 feet per hour.

Gasholder, Double Lift, with Cast-Iron Tank, capacity 37,000 feet.

Gasholder, Double Lift, capacity 100,000 feet.

Gasholder, Double Lift, with Cast-Iron Tank, Capacity 240,000 feet.

Two 12-in. Governors, by Wright, London, with 12-in. Valves, Bye-Pass, and Connections.

Two 12-in. four-way faced Valves, by Cockey.

For further information, &c., apply to the undersigned.

R. MORLAND, Engineer.

GAS PLANT FOR SALE.

A 10-in. Vertical Pipe Condenser, having 20 Pipes, each 19 ft. high, on Cast-Iron Base Box.

A Scrubber, 16 ft. high 5½ ft. diameter, fitted with thin boards, Self-Acting Liquor Distributor, 10-in. inlet and outlet pipes.

Two Single-Flue Cornish Boilers (new in 1870), each 9½ ft. long, 3 ft. 9 in. diameter; Fire Tube of Low Moor Iron, complete with all Fittings.

All in good working order; removed to make room for larger plant.

For further particulars apply to THOS. TREWHITT, Gas-Works, WEST HARTLEPOOL.

May 8, 1879.

GAS APPARATUS FOR SALE.

THE Dorchester Gas and Coke Company, Limited, have the following APPARATUS FOR SALE:—

Station-Meter, with Clock, 5000 feet per hour, Valves complete; 7-in. Connections.

Governor, Valves complete, and Connections; 7-in. diameter.

Box Condenser, 24 8-in. Pipes, Valves and Connections complete; 7-in. diameter.

Scrubber, 5-ft. diameter, 12-ft. high, fitted with Distributing and Flushing Apparatus; Valves and Connections complete, 8-in. diameter.

Two Gasholder-Valves, for working two gasholders, Inlet and Outlet, Cockey's patent, 10-in. Connections.

The whole are in good working order, and are to be sold to make room for extensions. Full particulars on application to the undersigned.

WM. OSMOND, Manager.

CONTRACTS.

THE West Houghton Gas Company are open to receive TENDERS for their TAR and AMMONIA LIQUOR, from June 30, 1879, to June 30, 1880. Quantity about 200 tons.

Tenders to be sent in, addressed to the Chairman, not later than July 16, 1879.

By order,
JOHN PICKUP, Secretary.

West Houghton, June 21, 1879.

J. BEALE'S NEW PATENT GAS EXHAUSTERS,

MANUFACTURED SOLELY BY

B. DONKIN & CO.

These Exhausters have but one solid slide, which ensures less wear and tear, and less friction, and thus fewer repairs are necessary. They are made with two outside bearings and all latest improvements.

MESSRS. B. D. & CO. ALSO MAKE

STEAM-ENGINES FOR DRIVING GAS EXHAUSTERS,
VALVES FOR GAS, WATER,
STEAM, HYDRAULIC MAIN, TAR, AMMONIACAL LIQUOR, &c.

WORKS: 55a, BLUE ANCHOR ROAD, BERMONDSEY, LONDON, S.E.

ECONOMY IN THE PRODUCTION OF GAS, AND CARBON DEPOSIT ENTIRELY PREVENTED.

PLUTONIC CEMENT,

FOR JOINTING AND REPAIRING RETORTS AND OVENS *in* ACTION AND *out* OF ACTION.

A Pamphlet on the advantages of the above, with Modes of Application, References, Prices, &c., free by post, from the Sole Manufacturer,

WILLIAM RICHARDSON, Gas and Hydraulic Engineer, CHARLES HENRY STREET, and BISSELL STREET, BIRMINGHAM.

Now Ready, Price One Guinea,

PRECEDENTS IN PRIVATE BILL LEGISLATION

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This Work contains information with regard to the practice of Parliament during the last fourteen years, in regard to most of the points on which differences arise in Opposed Bills for Gas and Water Undertakings, comprising—Authorized share and loan capital, Rates of dividend, Capitalization of profits, Term for the repayment of loans, Instances in which new shares are to be sold by auction and Exceptions to the Standing Order requiring new shares to be sold by auction, The limitation of back dividends, Illuminating power, Purity, Price, Notice before testing, The conditions under which the public supply of gas is regulated, Alteration of mains, Instances in which maps of mains are required, and All cases in which undertakings have been transferred, since 1845 in gas and 1865 in water, from Companies to Local Authorities.

In the Water Precedents will be found, in addition, The rates for a supply for domestic purposes, and the Rates for other than domestic purposes.

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WANTED, by Samuel Thompson & Co., Colliery Office, Lancaster, APPLICATION for PRICES from Gas Managers who are prepared to receive Tenders for GAS COAL or CANNEL.

John Leigh, Esq., M.R.C.S., F.C.S., &c., &c., in his analytical report of S. T. & Co.'s Coal, says: "It is remarkable for its purity, I have scarcely ever examined a Coal containing so small a quantity of ash, and when Cannel of the best description is scarce, it may well replace this material."

HENRY LYON (14 years Engineer and Manager of the largest of the Manchester Corporation Gas-Works) Mechanical and Consulting Gas Engineer, reports upon the condition and value of Gas-Works, supplies plans and specifications of all Apparatus appertaining to Gas-Works, and re-models existing Works.

Address Brooklyn, near Halliwell Lane, Cheetham Hill Road, MANCHESTER.

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Public Accountant,
MOORGATE STREET CHAMBERS,
GREAT SWAN ALLEY,
MOORGATE STREET, E.C.

Mr. ROBERT DEMPSTER,
CONSULTING GAS ENGINEER,
ELLAND, near HALIFAX,

May be consulted on all matters connected with Valuations, Arbitrations, and Parliamentary Applications connected with Gas-Works. Having been engaged on extensive Arbitration Cases, which, combined with his experience in Construction and Contracting, his knowledge of Engineering and Valuations is both extensive and reliable.

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Accounts Analyzed and Statistics Prepared for Parliamentary Proceedings, Arbitrations, &c.

The Forms of Account, which have been specially designed by Mr. Lass to meet the requirements of the Gas-Works Clauses Amendment Act, 1871, are now in use by many Gas Companies, Corporations, and Local Boards.

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Plans and Estimates furnished; Gas-Works, Apparatus, Pipes, Machinery, Fire Goods, &c., supplied, or Attested and Shipped for Exportation.

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MR. ROMANS has for upwards of 30 years been practically engaged in the Manufacture of Gas, and has, by extensive experiments, ascertained that by JUDICIOUS INTERMIXTURE of the lighter with the heavier gases, much of the rich Hydrocarbons CAN BE SAVED, which otherwise ARE LOST, during the process of manufacture. He is therefore enabled to give advice to those who favour him with their orders for Cannel, as to the class which will secure for their standard of illuminating power the HIGHEST ADVANTAGEOUS RESULTS.

ANALYSIS AND PRICES FORWARDED ON APPLICATION.

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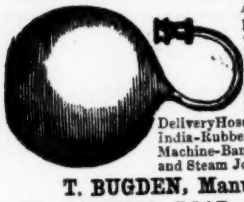

As supplied to the Imperial, Chartered, and other London and Provincial Gas Companies. Bellows and Valves for inflating Well Dresses, Stokers Gloves, India-Rubber Suction and Delivery Hose, Gas-Tubing, Leather, India-Rubber, and Gutta-Percha Machine-Bands, Sheet and Washers, and Steam Joints.

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TO MAKERS OF SULPHATE OF AMMONIA AND BUYERS OR SELLERS OF GAS LIQUOR.

F. SUTTON & CO., Norwich, are now prepared to Supply a Set of Apparatus with Standard Test Solutions for the rapid and accurate analysis of Gas Liquor, which can be used by any intelligent workman, so as to show the actual amount of Sulphate which can be got out of any sample of liquor in a few minutes, without any of the annoyance arising from saturation with acid, &c. Tables are also given, showing the quantity of acid of various strengths required for any given liquor, the accurate ounce-strength and percentage of pure ammonia, &c. Price of the set, with full direction and table (copyright), with materials sufficient for fifty analyses, £4 4s.

Post orders or cheques to be made payable to F. SUTTON AND CO., Manufacturing Chemists, NORWICH, who also supply every description of Standard Solutions for Volumetric Analysis of Waters, Beers, Manures, &c., of guaranteed accuracy.

WILSON CARTER AND PEARSON,
GAS COAL AND CANNEL FACTORS,
Supply to any Railway Station or for Export all kinds of Fuel for Gas purposes.
Address—CHIEF OFFICES:
TEMPLE BUILDINGS, 50, NEW STREET, BIRMINGHAM.

Now ready, Second Edition, price 7s., by post 7s. 3d., the
GAS MANAGER'S HANDBOOK.
By THOMAS NEWBIGGING, M.I.C.E.

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GAS *v.* ELECTRIC LIGHT.
WIGHAM'S PATENT GAS-BURNERS
FOR
STREET LIGHTING, &c.

Speaking of these burners, erected on the Thames Embankment by Westminster Bridge, the *Daily News* says:

". . . . . A blaze of light is thrown out, which, in point of efficiency and brilliancy, far surpasses the large gas-lamps lately erected in Waterloo Place, *while even the electric lights are quite thrown into the shade.*"

SOLE MANUFACTURERS:
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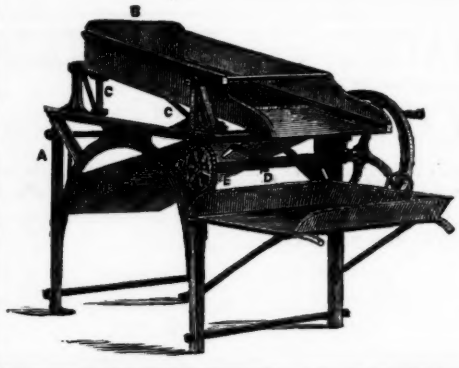


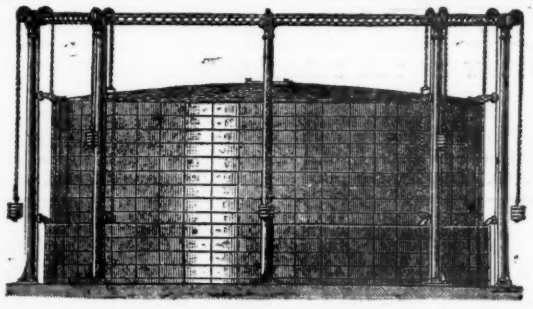
PRICE'S PATENT
LABOUR-SAVING SCREEN OR SIFTER.

In screening breeze, the coarse material falls on a tray supported by the handles of the Machine, thus making it convenient for picking the clinkers from the same, whilst the fine falls on a shoot behind, which is fixed to the bottom of the sieve B. In screening gravel or other material, the coarse will fall into a barrow direct, and the fine be conveyed by the shoot into a barrow at the other end, or at the bottom.

To practical men the advantages of this Machine will be evident. It secures at once a saving of time, labour, and expense, as by it a much greater quantity of material can be sifted in the same space of time.

Further particulars as to price, &c., may be obtained by applying to the Patentee (Hampton Wick), or to

ROBERT DEMPSTER & SONS,
(SOLE MANUFACTURERS),
ELLAND, NEAR HALIFAX.



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LINCOLN.

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ESTIMATES FOR GAS-WORKS OF ANY SIZE.
REFERENCES TO 500 WORKS ALREADY ERECTED.

N.B.—All Communications to be addressed to the FIRM ONLY.

THE WIGAN COAL & IRON COMPANY,

LIMITED,

DISTRICT OFFICE: 97, NEW STREET, BIRMINGHAM; AGENT: W. M'GOWAN,

Supply the Best Wigan Arley Mine Gas Coal, Gas Nuts, Gas Cannel, &c.

N.B.—The Wigan Coal and Iron Company, Limited, are exclusive owners of the well-known HAIGH HALL AND KIRKLESS HALL GAS COAL COLLIERIES.

GAS COAL. GAS COAL. GAS COAL.

WELLS, BIRCH, RYDE, and CO., Limited,

HOYLAND SILKSTONE COLLIERIES,

Near BARNSLEY.

This Company is now in a position to raise **2000 tons per day of REAL OLD SILKSTONE GAS COAL.**

"The quality of this Coal for Gas purposes, if equalled, is not excelled by any on record, and the Coke competes successfully with best Durham."—See *Mining Journal*, Aug. 11, 1877.

Prices quoted to any Railway Station, or F.O.B. Hull, Grimsby, Goole, Keadby, Liverpool, and Fleetwood.

Full particulars will be sent on application to above address.

LIVESEY'S PATENT WASHER.

This apparatus effects the most intimate contact between the liquor with which it is supplied and the gas passing through it, resulting in the complete removal of all particles of tar, increasing the ammonia strength of the scrubber and condenser liquor, and removing a large proportion of other impurities—notably, carbonic acid. The Washer is intended to work in conjunction with a scrubber. It occupies little space, and is inexpensive. It has been in successful constant use for nearly three years, does not become clogged with tar or corroded by the action of the liquor or gases, it gives three inches of pressure, and only needs a supply of liquor to keep it in regular action without any further attention.

For Particulars and Prices apply to

Messrs. DEMPSTER AND SONS, ELLAND, HALIFAX, for the North;

Messrs. BAILEY, PEGG, AND CO., Bankside, LONDON, S.E., for the South;

Messrs. WILLEY AND CO., Commercial Road, EXETER, for West of England and South Wales

Or to the PATENTEE, 589, OLD KENT ROAD, LONDON, S.E.

THE NEW GAS COOKER.

40 PER CENT. OF GAS SAVED.

No. A510 same as our **No. A152,**

BUT LINED WITH PATENT NON-CONDUCTOR.

Will Roast, Bake, and Fry, and with Three Burners for Boiling.

SIZE.

Outside—30in. high, 20in. wide, 20in. deep.
Inside—19½in. „ 14in. „ 17in. „

Price . . . . . **£4 14s. 6d.**

No. A500.

LINED WITH PATENT NON-CONDUCTOR.

Is fitted with Roasting and Baking Oven and Four Burners for Boiling.

SIZE.

Outside—34in high, 20in. wide, 19in. deep.
Inside—30in. „ 16in. „ 17in. „
Hot Plate—24in. by 23in.

Price . . . . . **£7 10s. 0d.**

No. A505.

Same as with Roasting and Baking Oven, a Broiler or Toaster, a Chop Griller, a Hot Water Boiler, and Three Burners for Boiling.

Hot Plate—26in. by 24in.

Price . . . . . **£9 15s. 0d.**

These Cookers are jacketed, on the sides, top, and door, with a new and very efficient non-conducting material, by the use of which a **saving** of gas to the extent of **40 per cent.** is effected.

Gas Companies who are selling or hiring stoves should see these stoves. Catalogues and particulars on application to

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London Warehouses: { 155a, Upper Thames Street, 1, Little Bush Lane.

SCOTCH CANNEL COALS.

The Subscriber is prepared to contract for the supply of all the principal SCOTCH CANNEL COALS. Prices and Analyses of the various Coals will be forwarded on application.

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CANNEL COAL MERCHANT,
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Established 1840.

PRICE'S PATENT COKE & COAL BARROW

effecting a great saving of time, labour, and expense.

For particulars, price, &c., apply to Mr. E. PRICE, Inventor and Patentee, Gas-Works, Hampton Wick, MIDDLESEX.

Prices are Reduced.

BELGIAN CLAY RETORTS.

J. SUGG and CO., late ALBERT KELLER, GHENT.—The removal of the import duties on Earthenware permitting the entry of Clay Retorts into England, Messrs. Sugg, of Ghent, beg to draw the attention of the Gas Companies of London, and other Cities, to the very superior quality of the RETORTS manufactured by them. They can be made of any size, in one piece, and of any form. The price will be in proportion to the weight, and very moderate in comparison to their value.

Communications addressed to J. SUGG & CO., GHENT, will receive immediate attention.

JAMES NEWTON & SONS,
(Established 1820,)
FIRE-BRICK AND TILE MERCHANTS,
Wholesale and for Exportation,
FALCON DOCK, 78 AND 79, BANKSIDE,
SOUTHWARK, LONDON, S.E.,
DEPÔT for STOURBRIDGE AND NEWCASTLE FIRE-BRICKS, LUMPS, TILES, and FIRE-CLAY, and every Article suitable for
GAS AND WATER WORKS.

TORBAY AND DART PAINT COMPANY, LIMITED.

WORKS:
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OFFICES:
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SOLE PROPRIETORS AND MANUFACTURERS OF
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W T I P

TRADE MARK

These Paints have been for many years extensively used in Her Majesty's Royal Dockyards, Woolwich Arsenal, the Shorncliffe and Curragh Camps, War Departments, and Colonies, and are largely supplied to Railway, Harbour, and GAS COMPANIES, Shipowners, Engineering Establishments, Railway Carriage and Wagon Works, and the Paint Trade generally. They are the BEST PROTECTORS of WOOD, CEMENT, and IRONWORK, even arresting corrosion after it has set in; and their base being oxide of iron, they are free from those properties which make lead paints so destructive to iron. They do not scale or blister, are not affected by great heat, and are the only Paints which will resist the effects of sulphuretted hydrogen. Their DURABILITY and covering properties have borne the test of A QUARTER OF A CENTURY'S PRACTICAL TRIAL.

The undermentioned colours—ground in best linseed oil, and requiring only to be thinned down for use in the ordinary way—are kept in stock:—

Torbay Brown.	Torbay Red.
Dart Green.	Slate.
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Brixham Black.	Torbay Chocolate.
Light Blue.	Cream Colour.
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Prices and Testimonials on application.

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Manufacturers of FIRE-BRICKS, LUMPS, TILES,

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BUILDERS AND CONTRACTORS
FOR THE ERECTION AND REBUILDING OF GAS AND WATER WORKS.
RETORT-SETTING—A SPÉCIALITÉ.
ROBUS'S IMPROVED RETORT-SETTINGS, guaranteed to Carbonize a large amount of Coal with a small per cent. of Fuel.
ESTIMATES GIVEN FOR MAIN-LAYING.
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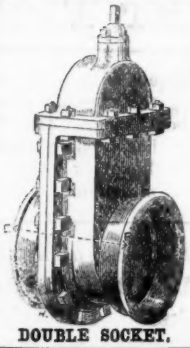
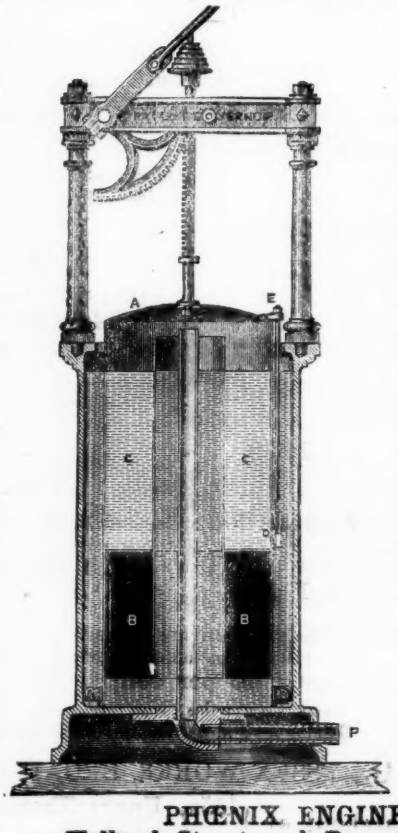
Address:—J. & H. ROBUS, BELL GREEN, CATFORD, LONDON, S.E.



DOUBLE SOCKET.

IMPROVED
SCREW WATER-VALVES,
WITH GUN-METAL FACES.
Proved to 400 feet head of water before leaving the Works
MADE EITHER WITH FLANGED OR SOCKET ENDS.
B. DONKIN & Co.,
BERMONDSEY, LONDON, S.E.

GEORGE WALLER & CO.,
GAS AND HYDRAULIC ENGINEERS,
Patent Compensating Steam Governor,
WITH SELF-CONTAINED WATER-BALANCE.



DESCRIPTION OF THE APPARATUS.

The illustration represents a section of the Patent Governor. The lower part of the Bell A is fitted with a loose Float B, and in the upper part of the Bell is a deep annular Water Chamber C, at the bottom of which is an opening D, with a slide outside regulated by a Screw Spindle E, to allow the water to pass in and out of the Chamber C quickly or slowly, according to circumstances, but when once adjusted the slide does **not require altering.** This Self-compensating Chamber gives great steadiness to the up and down movement of the Bell and effectively prevents the "hunting" motion so common with other Governors, thereby ensuring a more perfect action on the throttle-valve of the Engine **than attained by any other.** The sketch shows the clip lever fixed to work on throttle-valve at an angle, and can work in either direction. P is the Gas Inlet-pipe to Governor.

G. W. & Co. also make **special Steam Throttle Valves,** suitable for working with this Governor, and alter existing Throttle Valves to same plan.

PHŒNIX ENGINEERING WORKS,
Holland Street and Bear Gardens, Southwark, S.E.

F. & C. OSLER,

45, OXFORD STREET, LONDON, W.

MANUFACTORY AND SHOW-ROOMS:

BROAD STREET, BIRMINGHAM.

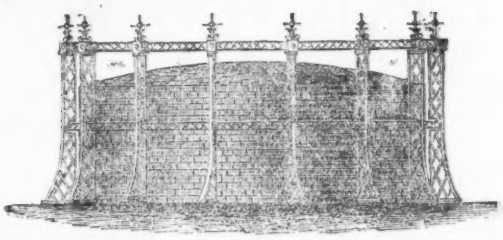
ESTABLISHED 1807.

MANUFACTURERS OF CRYSTAL GLASS CHANDELIERS.

WALL LIGHTS, AND LUSTRES FOR GAS AND CANDLES.

TABLE GLASS OF ALL KINDS.

CHANDELIERS IN BRONZE AND ORMOLU. MODERATOR LAMPS.



THE HORSELEY COMPANY,

LIMITED,

TIPTON, STAFFORDSHIRE.

LONDON OFFICE:

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GAS ENGINEERS, IRONFOUNDERS, &c.,

MANUFACTURERS OF

GASHOLDERS, WROUGHT AND CAST IRON TANKS, CONDENSERS, PURIFIERS, SCRUBBERS, MAINS, RETORT-LIDS, PLAIN AND DISHED LAMP-POSTS, PIPES,

AND ALL REQUISITES FOR EITHER

GAS OR WATER WORKS;

ALSO

MAKERS OF ROOFS, BRIDGES, &c.

S. OWENS & CO.,

WHITEFRIARS STREET, LONDON, E.C.,

HYDRAULIC ENGINEERS,

AND MANUFACTURERS OF

PUMPING MACHINERY of every Description.

SOLE LICENSEES AND MANUFACTURERS FOR GREAT BRITAIN OF

BLAKE'S PATENT STEAM-PUMPS,

More than 10,000 in use,

ESPECIALLY ADAPTED FOR USE IN GAS AND CHEMICAL WORKS, FOR PUMPING TAR, WATER, AMMONIACAL LIQUOR, ACIDS, &c.

The following are some of the prominent advantages of the BLAKE PUMP:—

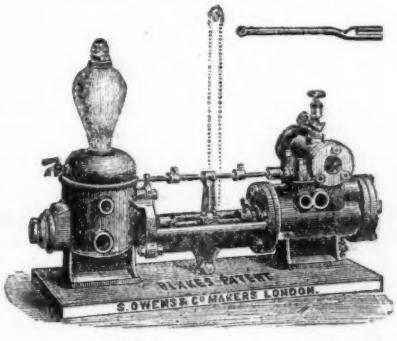
It will start at any point of stroke.

It has no dead point.

It works fast or slow, with the same certainty of action.

It is economical. Has a lead on the slide-valve.

It is compact and durable.



It is interchangeable in all its working parts.

It will deliver more water than any other pump.

It is made of best materials in the most workmanlike manner.

Can be worked at 20 strokes per hour, or 200 strokes per minute.

This Illustration represents Boiler-Feed Pumps, Sizes Nos. 1, 2, and 3, with Hand Lever for working Pump when Steam is not available.

SOLE MANUFACTURERS OF

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IMPROVED PATENT GAS-VALVES.

PRICED LISTS AND FULL PARTICULARS FURNISHED ON APPLICATION.

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Established 1799.

ROBERTSONS & CO.,

TWEED IRON-WORKS,

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Makers of Socket, Flange, and Hot-Water Pipes, Tank-Plates, Lamp-Posts, Columns, Girders, and Gas and other Castings.

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MANUFACTURERS OF

FIRE-BRICKS, LUMPS, TILES, RETORTS, &c.,

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Also Makers of all kinds of Common Building Bricks, and of Pressed White and Red Bricks for Facing.

BIRTLEY IRON WORKS,

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Manufactory for every description of Casting and Machinery for Gas-Works and Water-Works.

Warehouse in London for Cast-Iron Pipes and Connexions of all sizes and in any quantity, Scott's Wharf, Bankside, Southwark.

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JAMES OAKES & CO.,

ALFRETON IRON-WORKS, DERBYSHIRE,

AND

WENLOCK IRON WHARF, 21 & 22, WHARF ROAD, CITY ROAD, LONDON, N.,

Manufacture and keep in stock at their works (also a large stock in London) PIPES and CONNECTIONS 1½ to 48 inches in diameter; and make to order Retorts, Purifiers, and Tanks, with or without planed joints, Columns, Girders, Special Castings, required by Gas, Water, Railway, Telegraph, Chemical, Colliery, and other Companies.

NOTE.—Syphons and Covers are joint-faced if required, doing away with millboard and iron boring, or Syphons made without Covers, a socket being cast on and fitted with a small plug about 6 inches in diameter with lead joint. In either way preventing leakage.

THE

SILICA FIRE-BRICK CO.,

OUGHTIBRIDGE

Near SHEFFIELD,

Manufacturers of THE ORIGINAL SILICA OR DINAS FIRE-BRICKS. Specially adapted for Gas-Retort Furnaces and for Siemens's Gas-Furnaces. Shipments promptly executed to London, Liverpool, Hull, Grimsby, &c.

TROTTER, HAINES, & CORBETT,

BRETTELL'S ESTATE

FIRE CLAY & BRICK WORKS,

STOURBRIDGE.

Manufacturers of GAS-RETORTS, GLASS-HOUSE FURNACE & BLAST-FURNACE BRICKS LUMPS, TILES, and every description of FIRE-BRICK.

Proprietors of

BEST GLASS-HOUSE POT and CRUCIBLE CLAYS.

Successors to

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HARPER & MOORES,

PROPRIETORS OF THE

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Manufacturers of all Descriptions of

BEST STOURBRIDGE FIRE-BRICKS, LUMPS AND CLAY RETORTS

Of all Dimensions for Gas-Works,

GLASS-HOUSE POTS & CRUCIBLES

ESTABLISHED 1836.

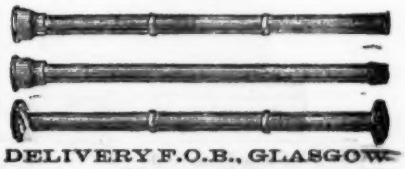
The Highest Award was obtained by H. & M., at the Philadelphia Exhibition, 1876, for Superior Quality of Manufacture. SILVER MEDAL, PARIS, 1878.

GAS AND WATER PIPES.

WILLIAM MACLEOD & CO.,

30, ST. ENOCH SQUARE, GLASGOW.

CAST-IRON GAS AND WATER PIPES.



DELIVERY F.O.B., GLASGOW.

Prices on application.

C. & W. WALKER,
8, FINSBURY CIRCUS,
LONDON, E.C.

MANN & WALKERS' PATENT SCRUBBER.

By Letters Patent in Great Britain, Europe, and the United States of America.

By some important improvements recently patented, the purifying power of these Scrubbers has been much increased, and a stronger ammoniacal solution obtained, which is found to absorb a large portion of the carbonic acid contained in gas, effecting an important saving in money and labour in the lime purifiers, and where oxide only is used, the increase in the illuminating power of the gas obtained by these Scrubbers is shown in a remarkable degree, in consequence of the large quantity of carbonic acid removed from the gas.

It is to be particularly noted that the im- portant results of these Scrubbers do not depend upon the machinery alone. The entire internal construction of the Scrubber bears an almost equally important part. For this reason, where it is desirable to convert existing Scrubbers, whose dimensions happen to be suitable, the work commences by ripping out the whole of the interior of the shell, and beginning the internal construction *de novo* from bottom to top.

Fifty million cubic feet of gas per 24 hours are purified from ammonia by these Patent Scrubbers in a winter's day in the gas-works of London, where the purity of gas supply is the highest in the world, under the chemical restrictions of the Board of Trade.

Generally, wherever a high standard of purification is maintained in the chief cities and towns of the British Provinces and of Europe, these Scrubbers have become established.

By their use the department of purification from ammonia upon a gas-works is made complete, without the aid of prepared oxide of iron, chemicals in purifiers, or any other supplementary process, and the whole ammoniacal residual product contained in the coal is absorbed and obtained in the form most profitable to a gas company, while the requirements of all Acts of Parliament and of the Board of Trade, relating to incorporate gas companies, are satisfied.

Foul Gas, properly condensed, entering the inlet is, by once only passing through the Scrubber, completely purified from ammonia with regular certainty day by day, without any further trouble, or any other process, effected by a very small quantity of clear water let into the machinery room at the top of the Scrubber, which is discharged at the liquor outlet at the bottom, from Newcastle coal at about 18 to 20 ounces strength, from Yorkshire and other coals generally from 25 to 30 ounces strength; while acidulated litmus or turmeric exposed at the Scrubber outlet will not show the slightest discoloration, and there is not a quarter of a grain of ammonia per 100 feet left unabsorbed.

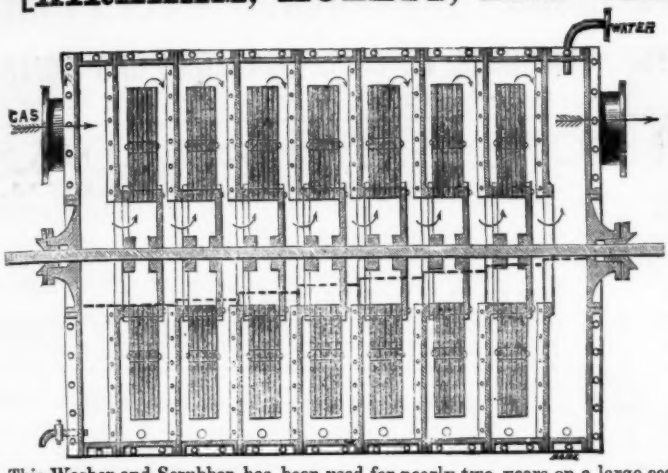
They contain their own engine power, requiring only a small inappreciable quantity of steam from the gas-works boiler, and are then complete in themselves, ready for service.

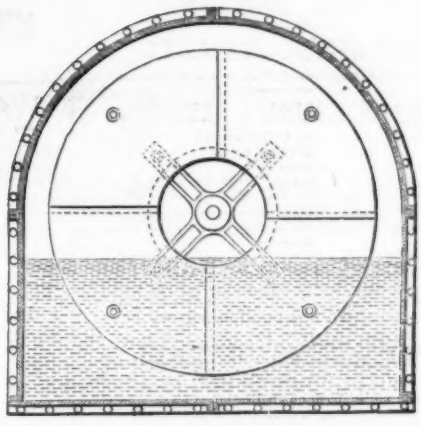
Applications relating to dimensions and prices should be addressed to us, C. AND W. WALKER, 8, FINSBURY CIRCUS, LONDON, E.C., or to Mr. WILLIAM MANN, late Superintendent of the Chartered Gas-Works, BLACKFRIARS, LONDON; they should state approximately the largest make of gas in 24 hours on a winter's day, and the smallest make on a summer's day, to be purified.

THE

"STANDARD" WASHER & SCRUBBER.

[KIRKHAM, HULETT, AND CHANDLER'S PATENT.]





This Washer and Scrubber has been used for nearly two years on a large scale at the Works of The Gaslight and Coke Company, Bromley-by-Bow, at which station there are now several in operation and in course of construction. There is also one in use at the Pancras Station, King's Cross, of the same Company, which is purifying 1,500,000 cubic feet of gas per day. At the Gas-Works of the Corporation of Leeds, a large one has been erected, which is giving complete satisfaction. The Special Merits of this Washer are as follows:—

That it is a very effective Condenser, so that it is not absolutely necessary to reduce the temperature of the gas to 60°, or thereabouts, to make the Washer effective. That the distribution of the liquor is made with unerring regularity. That it occupies very small space, so that it can be, at little expense, effectually protected from extreme changes of the weather. That the considerable expense of Coke or Wood, or other Scrubbing Material, is entirely saved, and that the great nuisance and cost of from time to time replacing the Scrubbing Material is avoided. That, by the revolution of the discs, the quantity of water carried up by them, and tending continuously to fall, exposes a very large amount of fresh wetted surface to contact with the gas. That it is particularly adapted for Gas-Works where Sulphate of Ammonia is manufactured. That it is much cheaper than any other Scrubber that will do the same amount of work effectually. That it is the only Washer suitable for purifying Gas from all its impurities by solution. That it works with a minimum of pressure. That it takes out every trace of Ammonia from the Gas in once traversing the machine. That it requires very little outlay for foundations.

The following Testimonials show the opinion of eminent Engineers as to the capabilities of the Washer:—

D. HULETT, Esq. *The Gaslight and Coke Company, Bromley-by-Bow, May 3, 1877.*

Dear Sir,—In answer to your inquiries respecting the results of the working of your Patent Washer, I beg to state that I find it a very efficient machine. I have had it in operation for some time, and passed gas through it continuously at the rate of 100,000 cubic feet per hour, and obtained from it 11 gallons of 10 oz. liquor per ton of coal carbonized—results which appear to me very satisfactory for so small a Washer. It works very smoothly, taking but little power, and giving no pressure. I have it still in operation, and am perfectly satisfied with its working.

I am, dear Sir, yours truly, (Signed) W. B. WRIGHT.

Messrs. KIRKHAM, HULETT, and CHANDLER. *The Leeds Corporation Gas-Works, York Street, Leeds, Dec. 6, 1878.*

Gentlemen,—The Scrubber-Washer erected by you at these works, and which has been in use for six months, has proved to be, so far as we have been able to test it, thoroughly efficient. We are at present making 32,000 feet of gas per hour, and are entirely dependent on this apparatus for the removal of Ammonia, and the **Gas is perfectly free from that impurity in the sixth chamber**, so that four chambers remain to deal with an increasing make of gas. Owing to insufficient condensers, the gas was in the summer admitted to the Scrubber at a temperature of 70°, but was reduced therein to 61°, or that of the atmosphere. The volutes are driven at the rate of four revolutions per minute, and, working at that speed, there is not the slightest difference between the inlet and the outlet pressure. Clean water supplied at the rate of 10 gallons per ton of coal carbonized is converted into liquor of from 10 oz. to 13 oz. strength **in once traversing the vessel.** The apparatus is extremely simple and compact, occupies but little space, and requires no foundation. I shall be surprised if it does not eventually become extremely popular.

I am, Gentlemen, yours faithfully, (Signed) HENRY WOODALL, Engineer.

Messrs. KIRKHAM, HULETT, and CHANDLER. *The Gaslight and Coke Company, York Road, King's Cross, Jan. 14, 1879.*

Gentlemen,—In reply to your inquiry, I am pleased to say, the Washer which was put in action at this station in October last has quite fulfilled my expectations, as it confirms the experiments I made in May last with the smaller machine. Working at four revolutions per minute, **it takes out every particle of Ammonia**, while purifying more Gas than it was intended to do. I enclose particulars of a fortnight's working during our heaviest make, by which you will see that it yields the full quantity and strength of liquor, and works with little pressure. I am therefore quite satisfied with the machine, and trust it may meet with the success it deserves.—I remain, &c. (Signed) JOHN CLARK.

The following Table shows the results of the working of one of these Washers, lately erected to purify 60,000 feet of Gas per Hour, at the St. Pancras Station of The Gaslight and Coke Company:—

1879.	Nos. of the Divisions and Strength of Liquor in each.										Water used per Ton of Coals.	Gas Purified per Hour, Cubic Feet.	Ammonia on Outlet.	Temperature.			Pressures.		Revolutions per Minute.
	1	2	3	4	5	6	7	8	9	10				Inlet.	Outlet.	Atmosphere.	Inlet, Inches.	Outlet, Inches.	
	oz.	oz.	oz.	oz.	oz.	oz.	oz.	oz.	oz.	oz.									
January 1	8¼	6¾	5	3½	2½	1½	¾	¼	0	0	10 Gallons.	52,000	Nil.	77°	73°	48°	24	23	7½
,, 2	8¾	7	6	4½	3¼	2½	1½	¾	¼	0	10 ,,	57,000	Nil.	73°	66°	32°	21¾	20½	4
,, 3	9¼	8	6	3¾	3	2½	1½	¾	¼	0	10 ,,	60,000	Nil.	75°	68°	40°	23½	22	4
,, 4	9¼	7¾	6¼	4¼	3¼	2¼	1½	¾	¼	0	10 ,,	65,000	Nil.	74°	68°	35°	24	22½	5
,, 5	9½	7	6	4	3	2½	1¼	1	¼	0	10 ,,	34,000	Nil.	77°	68°	35°	14½	14	5
,, 6	9¼	7¼	6¼	4¼	3	2¼	1¼	1	¼	0	10 ,,	63,000	Nil.	72°	66°	27°	24	22½	4½
,, 7	11	9	7	5½	3¾	3	1¾	1½	½	0	10 ,,	59,000	Nil.	74°	66°	31°	25	23½	5
,, 8	9½	7½	6	4½	3	2	1	¼	¼	0	10 ,,	78,000	Nil.	73°	61°	31°	28	26½	4½
,, 9	11	9	7	5	3¾	2½	1¾	1	¼	0	10 ,,	82,000	Nil.	74°	67°	33°	27½	25½	5
,, 10	10¾	8½	6¾	5	3¼	2½	1½	1	¼	0	10 ,,	66,000	Nil.	76°	64°	28°	28½	27	5
,, 11	12½	10	7¾	5¾	4¼	3¼	1¾	1¼	½	0	10 ,,	61,000	Nil.	73°	64°	27°	26½	25½	5
,, 12	11	8¾	6¾	—	—	—	1¼	¾	¼	0	10 ,,	39,000	Nil.	74°	64°	27°	26½	25½	5
,, 13	13	10¾	8¼	6	4¾	3½	2	1¼	½	0	10 ,,	78,000	Nil.	73°	65°	42°	28	26	5

Messrs. KIRKHAM, HULETT, and CHANDLER. *Corporation of Birmingham, Gas Department, Saltley Works, May 23, 1879.*

Gentlemen,—I beg to enclose you a copy of the results of the tests which, by the kind permission of the Engineer, Mr. Clark, I made on the 6th of March last, of the working of one of your "Standard" Washers and Scrubbers at the St. Pancras Station of The Gaslight and Coke Company, and I am of opinion that, for an apparatus occupying so small a space, they are exceedingly satisfactory.—Yours truly, HENRY HACK, Engineer.

Working Results obtained from KIRKHAM, HULETT, *and* CHANDLER'S *Patent "Standard" Washer and Scrubber at the St. Pancras Station of The Gaslight and Coke Company, London, March 6, 1879.*

Gas passing per Hour, Cubic Feet.	—	Impurities in Gas per 100 Cubic Feet.			Temperature.		Pressure in Inches.	Revolution of Apparatus per Minute.	—	No. of Divisions and Strength of Liquor.										Water Used during Experiment. Gallons.
		SH_2	CO_2.	Grains. NH_3.	Washer.	Air.				—	—	—	—	—	—	—	—	—	—	
64,000	Inlet	2·00	2·00	158·8	72	57	21	4¾	Twaddel deg. at 60°	5·3	4·9	2·85	2·35	1·7	1·05	0·6	0·3	0·15	0·1	65
	Outlet	1·50	1·50	0·8	68	57	20		Acid, ounces.	11·0	8·4	6·3	4·5	2·7	1·7	1·3	0·7	0·3	—	

WASHER-SCRUBBERS OF THIS PATENT ARE IN COURSE OF CONSTRUCTION FOR BECKTON, BRADFORD, GREENWICH, WOOLWICH, AND SEVERAL OTHER GAS-WORKS.

For further particulars and testimonials, address

Messrs. KIRKHAM & HERSEY, GAS ENGINEERS, 21, ABINGDON STREET, WESTMINSTER.

ROBERT MARSHALL,

CANNEL COAL MERCHANT,

198, ST. VINCENT STREET, GLASGOW.

SHOTT'S BOGHEAD.

HARTHILL CANNEL

Yields 14,920 cubic feet of 40·92-candle gas per ton.

THRASHBUSH CANNEL

12,530 cubic feet of 40·22-candle gas per ton, and 9 cwts. of good coke.

LOTHIAN'S CANNEL

Yields 12,500 cubic feet of 34-candle gas per ton, and 9 cwts. of excellent coke, containing only 4 per cent. of ash.

MUIRKIRK, No. 1, CANNEL

Yields 12,160 cubic feet of 32·5-candle gas per ton, and 10 cwts. of excellent coke, containing only 5 per cent. of ash. This cannel is almost free from sulphur.

OLD WEMYSS CANNEL

Yields 13,320 cubic feet of 32·5-candle gas per ton.

Prices and full analyses on application at above address, or from WEDDERSPOON, FERGUSSON AND Co., 21, Lime Street, LONDON, E.C.

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THE MIRFIELD COAL COMPANY are supplying GAS COAL of the best quality on trucks at their siding. This Coal contains 10 per cent. of Cannel, and, as analyzed by Mr. JAMES Paterson, of Warrington, yields 12,600 *cubic feet of* 16·67 *candle gas, with* 1430 *lbs. of good Coke, per ton.* Ash in Coke, 1·88.

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THE BROUGHTON COAL COMPANY,

COLLIERIES, NEAR WREXHAM,

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This Coal yields more than 10,000 cubic feet per Ton of gas of good quality, *in practical working on the large scale.*

A large purchaser reports the coke to be clear, of a quality rarely equalled in the retort-furnace, and much liked by the stokers.

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This Coal is now highly approved of for gas making, and yields over 10,000 feet per ton of 15-candle gas, and about 14 cwt. coke.

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One ton yields 12½ cwt. of good coke. This Coal can be shipped from Hull, Goole, Liverpool, Morecambe, and Barrow.

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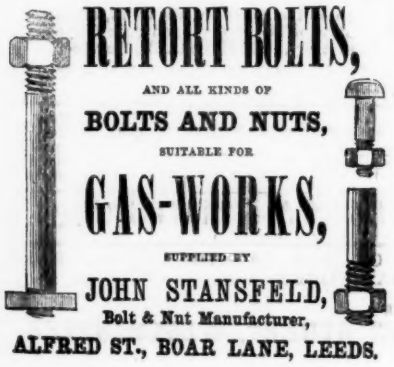

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PATENTEE and MANUFACTURER of the following Inventions:—

RETORT SETTINGS—giving great Economy of Fuel.

STEAM-ENGINES and EXHAUSTERS, FOUR-WAY VALVES, WASHERS, SCRUBBERS.

FUEL-MACHINE, for Compressing Breeze and Tar.

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J. & J. BRADDOCK,

GLOBE METER-WORKS,

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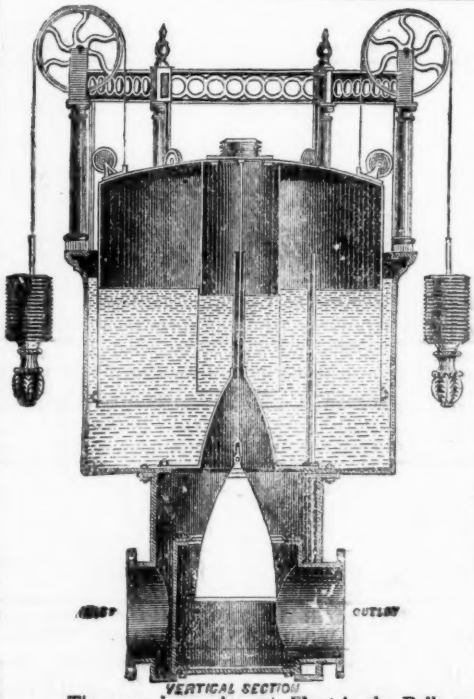
Beg to submit to Gas Engineers their

PATENT COMPENSATING GAS GOVERNOR,

Which is designed to give an uniform pressure at the Outlet to the Main at all draughts up to the full quantities which the Governors are made to control, such outlet pressure being less than the initial pressure.



VERTICAL SECTION.

The uniformity of pressure is obtained by introducing a compensating chamber into the Bell or Holder of the Governor, which compensator is of the same area as the valve, both of which are operated on by the initial pressure, thereby placing the valve in equilibrium, no matter what the initial pressure may be. The action on the Bell is by the Gas passing along a pipe from the outlet, and the pressure is regulated by weights in connexion with the Bell as required.

From the sectional elevation attached hereto, it will be seen that only the Gas required to operate the Bell comes in contact with the water of the tank, which water will remain comparatively sweet and free from odour. That in case of accident to the Bell, no more Gas can escape than would pass up the pipe covering the valve-rod and Bell supply-pipe.

These Governors have been made and sent out of various sizes for from 2 to 24-inch Mains, and give most satisfactory results.

They can be made with Float in the Bell, or counterpoise as per section.

THE SILKSTONE & DODWORTH COAL & IRON COMPANY, LIMITED,

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REAL OLD SILKSTONE GAS COAL.

JAMES PATERSON Esq., Gas Engineer, of the Warrington Gas Company, reported, Aug. 10, 1875:—

"This Coal possesses remarkable qualities as a gas and coking coal, and appears SECOND TO NONE IN THE KINGDOM. It contains the large quantity of 699 lbs. of illuminating matter, and 1498 lbs. of coke to the ton, and produces **12,240** cubic feet of 16·66 candle gas."

The above Company are raising nearly a thousand tons of the Real Old Silkstone Gas Coal per working day.

PRICES QUOTED TO ANY RAILWAY STATION, OR F.O.B. HULL, GRIMSBY, GOOLE, KEADBY, LIVERPOOL, AND FLEETWOOD.

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SILVER MEDAL
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SPECIAL NOTICE.—Our Patent Machine-Made Retorts have now been thoroughly tested, and have proved themselves infinitely superior to those made by hand. At several large works it has been settled, beyond question, that, owing to the compactness and general excellence, more gas is sent to the gasholder from each ton of coal carbonized than is the case with hand-made Retorts.

NEWTON, CHAMBERS, & CO.,

THORNCLIFFE IRON-WORKS AND COLLIERIES,
NEAR SHEFFIELD.

CELEBRATED SILKSTONE GAS COALS.

The various descriptions of Gas Coal produced from the above Collieries possess an unequalled reputation, combining in a large degree the constituents essential for the production of the best quality of Coke and Gas of a high illuminating power.

A recent extensive development of the Collieries enables us to offer increased supplies.

JAS. PATERSON, Esq., of Warrington, after testing various qualities of our Coal, has sent the following testimony of their merits:—

"*Warrington Gaslight and Coke Company,*
Offices, Mersey Street, Warrington, April 23, 1877.

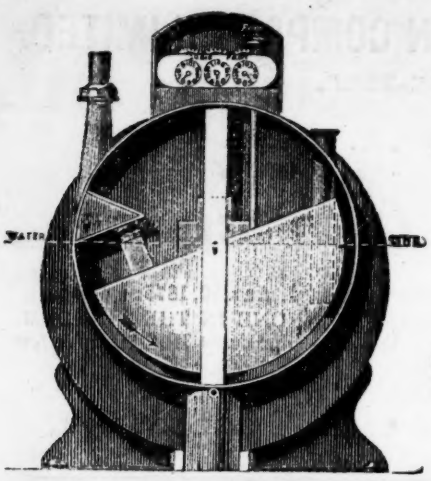
"MESSRS. NEWTON, CHAMBERS, AND CO.,

"GENTLEMEN,—After carefully testing the various samples of Gas Coals sent from your Collieries for analysis, I have pleasure in reporting them as belonging to the highest class of Gas and Coking Coals.

"The average of Nine samples gives a yield of **12,500** cubic feet of **15½**-Candle Gas, being equivalent to **664** lbs. of sperm per ton, and **1420** lbs. of fixed carbon of a very superior quality. All the samples bear a close relation to each other in value.

"Yours truly, "JAMES PATERSON."

Full particulars will be sent on application to us—address as above.



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Over 120,000 in action.

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METERS, BOXES, REGULATORS, AND ALL REQUISITES FOR PUBLIC LIGHTING

TESTING APPARATUS for all purposes relating to Gas, &c.

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IMPROVED DRY GAS-METERS, in Cast-Iron or Tin-Plate Cases;

STATION-METERS, ALL SIZES, up to 15 feet Square, with PLANED JOINTS;

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Effecting a great saving in the cost of discharging Coals from Vessels, Barges, &c. Several of these Cranes, with the necessary power, are now being erected at Beckton, Hull, and other Gas-Works.

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Sixteen recently erected at Beckton, applied to Covers 30 feet square.

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